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DICHOPHYLLUM MOOREI AND CERTAIN ASSOCIATED SEEDS

HENRY N. ANDREWS
Instructor, Henry Shaw School of Botany of Washington University

A few years ago Elias (Moore et al., '36) described a flora from the Upper Carboniferous of east-central Kansas which contained certain elements such as *Walchia* and *Taeniopteris*, plants generally accepted as more typical of higher horizons. In many ways the most interesting and certainly the most novel member of the flora is the plant described as *Dichophyllum Moorei* (fig. 1). In the hope that a more detailed knowledge of it might shed light on the general problem of leaf morphology in the seed plants we visited the type locality in the summer of 1939 and made a small collection. Excavations carried on during the following summer yielded some excellent specimens, and although much remains to be known about this interesting fossil sufficient information has been obtained to warrant a short note on its gross morphology.

Occurrence of the Fossils.—

The locality from which both Elias' and our own specimens were obtained lies about six miles northwest of Garnett, Kansas (Section 32, T. 19S, R. 19E), which is in the Victory Junction member of the Stanton limestone and of Upper Carboniferous age. Its stratigraphy has been carefully worked out (Moore et al., '36), and despite the Permian aspect of the flora there seems to be no doubt that its age as given is correct.

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Some difficulty attended collecting due to the indisposition of the owner on whose property the original quarry is located. It was found, however, that excellent material could be obtained only a few inches below the surface of the adjoining county road less than 100 yards from the quarry. For permission to dig in the road I wish to express my appreciation to Mr. Ray Hardin, Anderson County Road Commissioner.

Dichophyllum Moorei Elias.—

The appearance of this plant may best be gained from the restoration (fig. 1), as well as figs. 2 and 3 which served as the basis for fig. 1. In the most complete specimens the main axis is observed to break up near the distal end into two or three main branches which in turn divide, ultimately resulting in two or three subdivisions or telomes. Since there is no reason to believe that we are dealing with a fern the term pinnule will not be applied to these final subdivisions. It is significant to note that the plant possesses a well-developed cuticle, a point that supports the supposed xerophytic nature of the flora and suggests gymnospermous rather than filicinean affinities. Unfortunately the cellular details of the cuticle are poorly preserved, and macerations have proven of little value.

Lateral branches may be observed in fig. 3. These start to divide almost immediately in the same dichotomous fashion as the distal branches. It has been suggested by Jongmans (Moore et al., '36, p. 16) that these specimens are referable to *Callipteris flabellifera* (Weiss) Zeiller, but Elias has pointed out that "they differ distinctly chiefly by the character of the lateral pinna; in the species from Kansas they are palmate, while in the European form they are pinnate." I am entirely in agreement with Elias in making a generic distinction between *Callipteris* and *Dichophyllum*, but I believe that our specimens of the latter clearly reveal that they are not strictly palmate but rather present a combination of pinnate and dichotomous branching. In some specimens (fig. 6) the secondary branching at first glance appears to be palmate but it is evident from figs. 3, 4 and 7 that it is more in the nature of a uniform dichotomy, with never more than two or three terminal subdivisions arranged in a strictly palmate fashion.

A comparison of the specimens illustrated here with *Callipteris flabellifera* (Gothan, in Potonié, '07) reveals a rather sharp distinction in the mode of branching of the two, the frond of the latter being pinnately divided in contrast to the pinnate-dichotomous branch system of *Dichophyllum*.

The indirect evidence available shows that there is no reason to refer this plant to the Filicineae as its supposed inclusion in the genus *Callipteris* might suggest. The rather heavy cuticle and associated seeds (p. 379) point toward a gymnospermous plant. Although a further consideration of the affinities of *Dichophyllum* must be speculative certain comparisons are not without significance.

The fossil record has supplied a wealth of evidence which indicates that the leaf of modern ferns has been derived from a branch system which became confined to a single plane and progressively webbed. It is, moreover, highly probable that such a phylogenetic trend has resulted in the typical bilobed leaf of the modern *Ginkgo*. Although it is true that a single *Ginkgo* tree may harbor much foliar variation, chiefly in the degree of dissection of the lamina, the farther back we go in geologic time the more finely divided the leaves become until they pass over imperceptibly (at least as far as this character is concerned) into typical *Baiera* species. In *Baiera spectabilis* and *B. Lindleyana*, for example, there is little left that one can call a lamina. It seems likely that here, as with the ferns, a branch system has given rise to the lamina, and it is possible that we may partially bridge the gap between the "leaves" of the above-mentioned species of *Baiera* and a branch system proper through a form such as *Dichophyllum*. It must be emphasized that the latter is not postulated as a "missing link" in a direct line of development but rather as a representative stage in the transition of side branches to a leaf-like structure composed of petiole and blade.

The morphology of *Dichophyllum* is particularly interesting in the light of Mrs. Arber's recent ('41) interpretation of leaf and stem in the angiosperms. The mode of branching that is found in *Dichophyllum* and *Psygmophyllum*, as well as certain of the better-known Coenopterid ferns, adds weight to her

conception of the *shoot* as the basic unit of plant structure. In so far as we know these forms, it is not possible to relegate their branch system to the classical categories of stem or leaf, and it is probable that the term shoot will be a generally acceptable one.

Mrs. Arber's concepts are not concerned with phylogeny. She specifically states: "This view has no phylogenetic implications; it does not commit us to any opinion as to the origin of the leaf as a matter of history, but is concerned with what the leaf actually *is*, here and now." It seems legitimate, however, to expand this concept to include certain apparent phylogenetic possibilities. A comparison of a long shoot of *Ginkgo biloba* with the shoot of *Dichophyllum* as restored in fig. 1 reveals a striking similarity in basic structure. The dichotomous side branches of the latter may well be the forerunners of the deeply dissected Baieras which in all probability are ancestral forms of the modern *Ginkgo*.

The closest affinities of *Dichophyllum* seem to lie with certain species of the genus *Psygmophyllum*, especially *P. cuneifolium*. There is, however, considerable variation in *Psygmophyllum*, and it is perhaps doubtful whether it constitutes a natural assemblage of species. Whether this be so or not the species included in that genus strongly suggest that leaves as they appear in *P. Kidstoni* may have had their origin from such forms as *P. cuneifolium*, where we find a branch system not unlike *Dichophyllum*, through *P. Grasserti* with its deeply dissected "leaves." (For a more detailed description of *Psygmophyllum* see Seward, '19, p. 79–90).

Associated Seeds.—

At least four or five species of seeds occur with the other plant remains at Garnett.[1] Of these one is of particular interest because of its abundance, its frequent association with

[1] The large number of clearly defined and apparently new seed species found here is of considerable interest. Some certainly belong to the coniferous remains, while others are probably referable to the pteridosperms or other gymnospermous groups. It is proposed to include a detailed consideration of these seeds at a later date in a general revision of American Carboniferous seed impressions and compressions.

Dichophyllum and its various features which set it apart as generically distinct from anything previously described.

The seed in question is characterized by two prominent horn-like projections at the micropylar end (figs. 8, 9, 10) and appears to be comparable with that figured by Elias as *Samaropsis* n. sp. B. However, according to the accepted concept of *Samaropsis* (Seward, '17, pp. 348–354), that genus is distinctly winged while our specimens show no semblance of a wing. Because of this disagreement and since they do not conform to any described genus it is proposed to assign to them a new binomial.

Diceratosperma Carpenteriana gen. et sp. nov.—

Samaropsis n. sp. B. Elias, in Moore, Elias and Newell, A "Permian" flora from the Pennsylvanian rocks of Kansas. Jour. Geol. **44**: 12, *fig. 7(5)*. 1936.

Seeds, presumably platyspermic, 6.0–8.0 mm. long, 3.5–4.0 mm. broad. Two prominent horns, approximately one third as long as body of seed, at micropylar end. Presence of pollen chamber indicated by papilla-like cast between horns.

Locality: six miles northwest of Garnett, Kansas: Section 32, T. 19S, R. 19E. Horizon: Victory Junction member of the Stanton Limestone, Missouri Series. Age: Upper Carboniferous. The species is named in honor of Mr. A. C. Carpenter of Ottawa, Kansas, whose knowledge of the local geology and willing cooperation greatly facilitated my collecting.

Acknowledgment.—

I am indebted to Dr. M. K. Elias for placing unpublished photographs of *Dichophyllum* at my disposal and for helpful suggestions concerning the Garnett flora.

Literature cited.—

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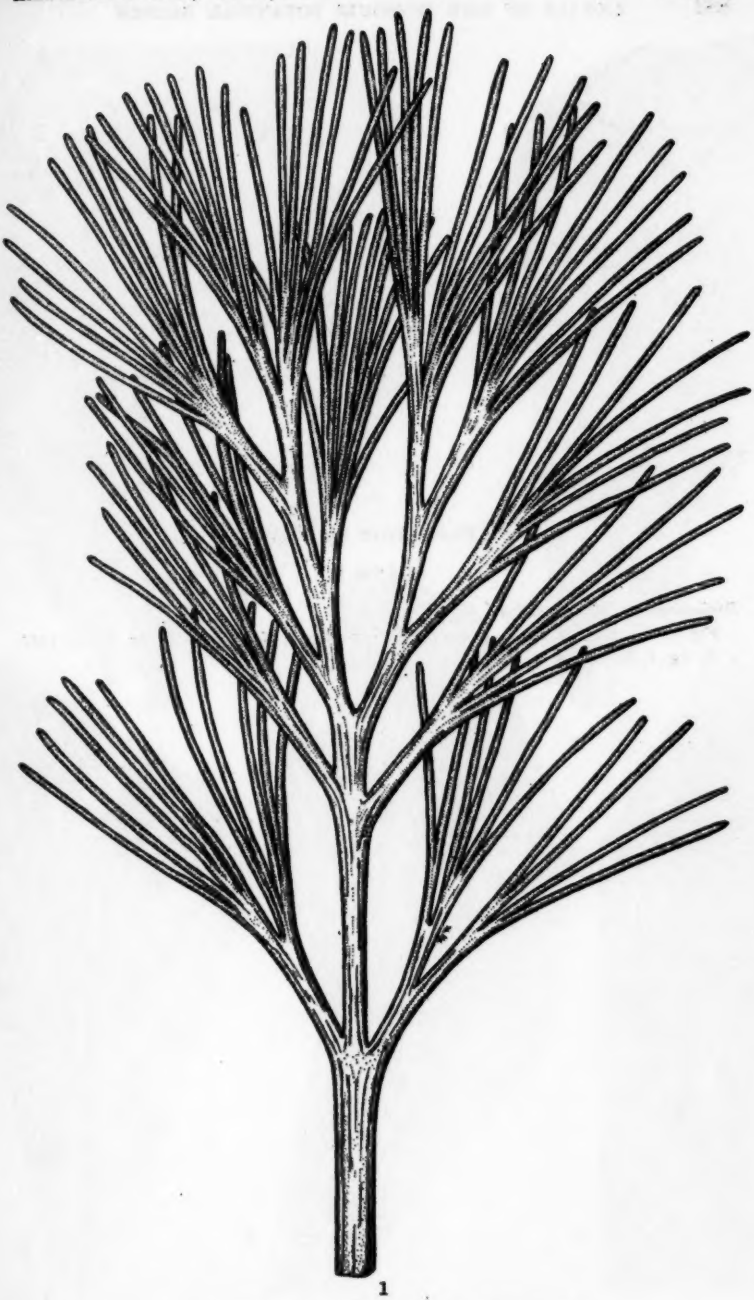
Explanation of Plate

PLATE 13

Fig. 1. Restoration of *Dichophyllum Moorei* Elias.



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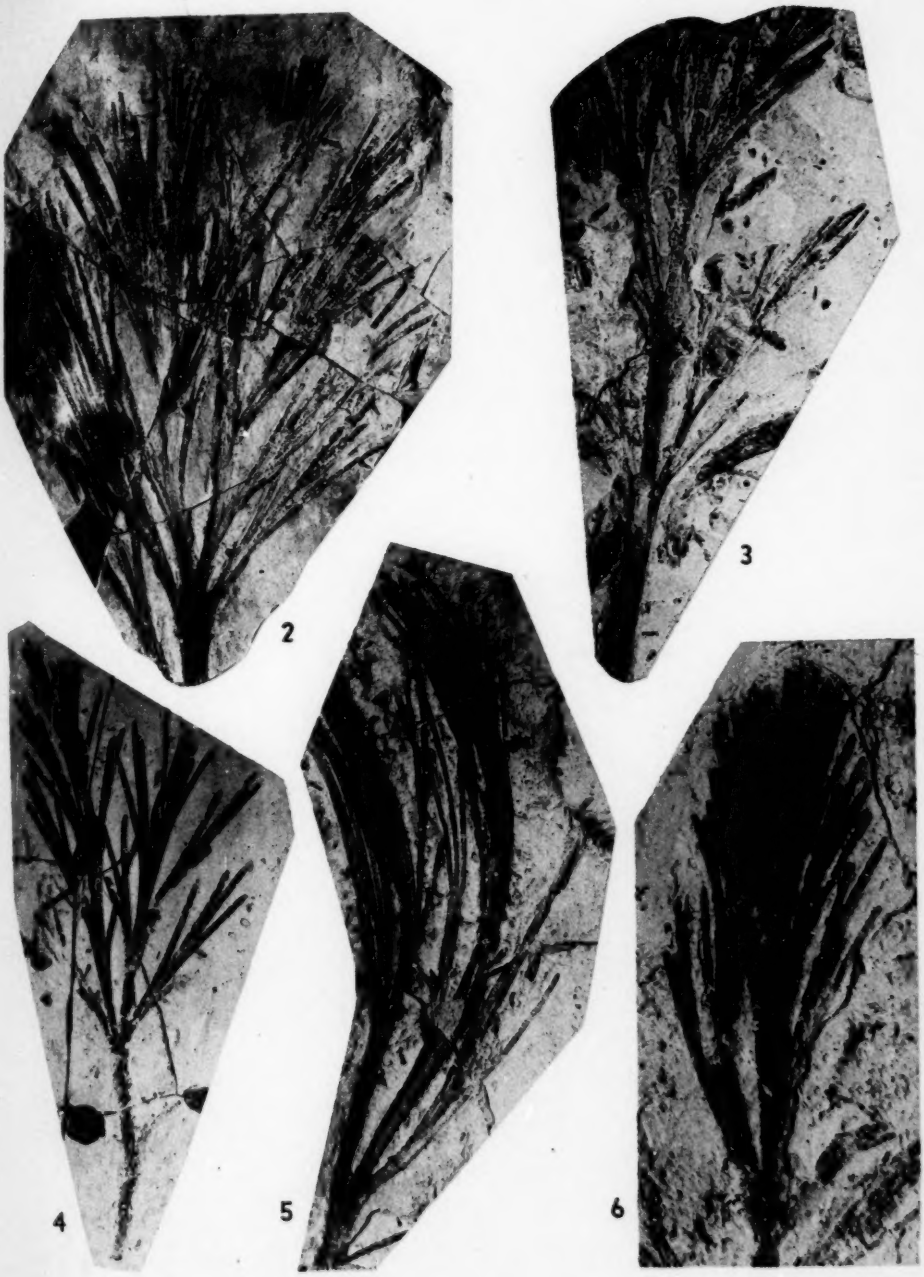
ANDREWS—DICHOPHYLLUM MOOREI

Explanation of Plate

PLATE 14

Dichophyllum Moorei Elias

Fig. 2, No. 1432, × .5; fig. 3, No. 1433, × .5; fig. 4, No. 993, × .6; fig. 5, No. 1227, × .6; fig. 6, No. 1428, × 1.



ANDREWS—DICHOPHYLLUM MOOREI

Explanation of Plate

PLATE 15

Fig. 7. *Dichophyllum Moorei*, No. 1425, × 1.

Figs. 8, 9, 10. *Diceratosperma Carpenteriana*, Nos. 1434, 1435, 1436 respectively, all × 6.3.

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ANDREWS—DICHOPHYLLUM MOOREI

A REVISION OF THE NORTH AMERICAN SPECIES OF THE GENUS ANISACANTHUS[1]

STANLEY HARLAN HAGEN

Formerly Assistant in the Henry Shaw School of Botany of Washington University

Introduction

Anisacanthus is a small genus of the Acanthaceae, which, because of the relatively few collections and the obscure specific characters, has been poorly understood. The present study was undertaken to correlate the morphological characters of the taxonomic entities of the genus as a whole, and to determine the relative value of the different characters in specific and varietal delimitation.

Anisacanthus is one of several genera segregated from *Justicia*, having been described by Nees[2] in the year 1842. He based it on *Justicia quadrifida* Vahl,[3] which in turn was founded on *J. coccinea* Cavanilles,[4] a plant grown in the gardens of Madrid from stock brought from Mexico probably in the latter part of the eighteenth century. Vahl had changed the species name from *coccinea* to *quadrifida* because of the earlier *J. coccinea* Aublet. Under the name *Justicia quadrifida* Vahl, it was not infrequently cultivated in European gardens; and fortunately several authentic specimens from horticulture have been preserved in herbaria. Nees, however, soon changed the name of the type species to *Anisacanthus virgularis* (Salisbury) Nees,[5] and as such it was known until Standley revived the specific name *quadrifidus*.[6]

[1] An investigation carried out in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of master of science in the Henry Shaw School of Botany of Washington University.

[2] Nees ab Esenbeck, C. G. Linnaea **16**: 307. 1842.

[3] Vahl, M. Enum. Pl. **1**: 124. 1805.

[4] Cavanilles, A. J. Icon. et Descr. Pl. **2**: 77, *pl. 199*. 1793.

[5] Nees in DC. Prodr. **11**: 445. 1847.

[6] Standley, P. C., Contr. U. S. Nat. Herb. **23**: 1343. 1926.

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Three of the species of *Anisacanthus* have been segregated from other genera. Nees transferred *A. pumilus* from *Justicia,* and Gray removed *A. Wrightii* and *A. Thurberi* from *Drejera. A. insignis, A. abditus, A. Gonzalezii,* and *A. tulensis* have been described from collections of later explorations.

Grateful acknowledgment is made to Dr. George T. Moore, Director, for placing at the author's disposal the splendid facilities for study offered by the Missouri Botanical Garden, and Dr. J. M. Greenman, Curator of the Herbarium, for his guidance during the study and for securing loans of materials needed. The author also appreciates the helpful cooperation of the librarians, and the constructive criticism offered by other members of the staff.

General Morphology

Stems.—The genus *Anisacanthus* consists of suffruticose plants, varying from erect to prostrate in habit, and mostly less than a meter in height or length. The wood is tan or brown in color, evenly grained, soft and brittle to relatively hard. The bark of the upper branches is thin, fibrous, rather brittle, exfoliating in longitudinal strips; on the lower branches it is gray, and relatively fine-grained. Stem pubescence is mostly confined to two opposite longitudinal strips continuous with the base of the petioles. The stem is terete, usually minutely fluted or striate.

Leaves.—The leaves vary considerably on a single plant, but within fairly consistent ranges throughout the group. The mature leaves are usually lanceolate-acuminate with acute or obtuse bases, but sometimes with broader and cordate bases. In one species, *A. insignis,* the linear and sessile leaf-characters serve as a basis for segregating the variety *linearis.* Dietrich, in describing *Justicia pumila,* mentioned the fact that the base of the leaf-blade was somewhat oblique. This character is not confined to that one species, however, but is infrequently found in others. Cystoliths are usually noticeable on the upper surface, especially if the leaf is glabrous. Punctate

glands on the lower surface are also characteristic of the group. Pubescence, when present, is mostly of short hairs thinly scattered over the surface or limited to few hairs along the veins, midrib, and petiole.

Inflorescence.—The inflorescence is of the indeterminate class. It may be a spike, raceme, or a panicle; in some cases the spike may be secund. If paniculate, the axis is usually shortened so that the cluster of flowers appears more like a head than a panicle. Considerable variation may be observed in the nature of the inflorescence, such as a secund spike with a single flower at a node, two opposite axillary flowers at a node, flowers 2 or 3 in each axil, an open or a shortened panicle. While a particular form of inflorescence is characteristic for certain species, there is usually some variation, even on the same plant.

The bracts are usually sessile, more or less triangular, acute, with the same general sort of pubescence as that of the calyx and the pedicel. Bracteoles are smaller, but similar in form. Both bracts and bracteoles are usually caducous, but may persist until the flower is fairly mature.

Calyx.—The calyx furnishes the more important characters in specific delimitation. These characters are quite consistent and easily distinguished with a lens. One of the striking features is the type of pubescence; with the exception of *A. Gonzalezii,* which is essentially glabrous, the surface is covered either with pilose or glandular hairs, or even with sessile glands. There may be some hairs present with the glands, but one type or the other is dominant. The glandular hairs are usually stipitate, the stipe cells being hyaline and the secretory cell at the tip brown. In one or two species the glands are reduced, sessile, and merge into puberulence. In *A. quadrifidus* and *A. Wrightii,* the calyx is sessile or only very shortly pedicellate. The calyx-lobes range in size from shallow ones 1–2 mm. long, as in *A. Wrightii,* to the tentacular and subulate ones, 2 cm. long, as in *A. Thurberi.* All measurements were taken from calyces in fruit or full flower, as the calyx is accrescent.

Corolla.—When Nees segregated *Anisacanthus* from *Justicia* he described the corolla as having an entire posterior lip. However, earlier workers were correct in describing the lip as slightly emarginate; both types occur and variations may be found on the same plant. The corolla is tubular or funnel-shaped, more or less curved, with spreading, recurved, ligulate to elliptical lobes. The mature corolla is from 3½ cm. in length, with the lobes usually about as long as the tube. The total length, the length of the tube and lobes, and relative ampliation at the throat are of importance in specific delimitation. The corolla is usually bright red and thinly covered with short, pilose, red hairs. In only one species, *A. abditus,* is the corolla glabrous.

Stamens.—The stamens are inserted on the corolla-tube, alternate with the lobes and usually near the base of the central lobe of the 3-parted anterior lip. The filaments are highly colored and vary in length with the corolla-lobes, seeming to extend to the tips of the lobes. The anther-sacs of *Anisacanthus* are essentially parallel, equal, and inserted at the same height on the filament; these characters are key characters in generic delimitation. The filament is attached at the base of the connective which joins the sacs from about half to two-thirds of the length from the top.

Pistil.—The ovary is partly surrounded at the base by a disc. The style is filiform, as long as the corolla, and terminates in a slightly enlarged 2-lobed stigma. The characters of the ovary, style, and stigma are essentially the same for all species, and thus of little taxonomic importance.

Fruit.—The capsule is generally uniform throughout the genus, but in a few cases it presents characters of taxonomic value. It is typically a subglobose, 2-celled body and a relatively distinct stipe of more or less equal length. In *A. Gonzalezii* the body is not separated from the stipe by a noticeable constriction, but gradually tapers to the base. The seeds are 2 to 4 in number and are usually nearly parallel and opposite in the capsule. They vary only slightly within the genus, being

more or less discoid, tuberculate and shiny, and held upright at maturity by curved retinacula.

Generic Relationships

Anisacanthus is a member of the tribe Justicieae and the subtribe Eujusticieae which is usually placed near the end of the family. The tribe includes plants with a 2-lipped corolla, 2–4 stamens with 1–2-locular anthers. As regards other members of the tribe, the genus appears to be closest to *Carlowrightia.* However, *Anisacanthus* has a much larger calyx, corolla, and fruit; and the corolla is 2-lipped (3 plus 1 lobes), whereas in *Carlowrightia* it is about equally 4-parted. *Anisacanthus* is a much larger plant than *Carlowrightia* and, so far as known, contains no herbaceous species as does *Carlowrightia.* It appears to be fairly closely related to *Chileranthemum* and *Odontonema,* but is probably more advanced than these genera, since it lacks staminodia which they possess. Mucronate appendages at the base of the anther sacs are wanting in *Anisacanthus;* by this character alone it may be distinguished from *Justicia.* Also the anther-sacs are less equal and more oblique in *Justicia. Anisacanthus* also has been confused with *Beloperone,* but this genus has mucronate appendages on the anther-sacs and is more closely allied to *Justicia.* Moreover, *Anisacanthus* is quite closely related to *Jacobinia* with which it has been frequently confused. They both lack the appendages on the base of the anther-sacs, but the equal and parallel anther-sacs of *Anisacanthus* readily distinguish it from *Jacobinia.*

Relationship of the Species

While the author has not divided the genus *Anisacanthus* into subgenera or sections, there are certain groups of species which are more closely related to each other than to others.

From the calyx alone it is evident that *A. pumilus* shows closest relationship to *A. tulensis,* the main difference being in size (pl. 17, l and m). The relationship is also indicated by the

slender, ligulate-lobed corolla, and by the consistent number of 4 seeds in the capsules of both species.

Similarly, the calyx of *A. Thurberi* appears to be an exaggerated form of that of *A. insignis* (pl. 17, i and h). However, these two species are not as closely related as are *A. tulensis* and *A. pumila*. The size and proportions of the corolla parts differ, and the seed number is not consistent in *A. insignis*.

The type species, *A. quadrifidus*, seems closest to *A. Wrightii*. The calyx is quite similar, although differing in proportions (pl. 17, f, g, and j). As a matter of fact, the more deeply cleft calyx form in *A. Wrightii*, which is found generally in plants of the area between the two species, was first described as *A. junceus* and later placed in synonymy under *A. quadrifidus*. The size and form of the corolla and the characteristic secund spicate inflorescence give additional evidence of the relationship.

Although the calyx of *Anisacanthus abditus* somewhat resembles that of *A. quadrifidus* (pl. 17, k), several characters segregate it from all the other species. The large bracts, the nature and extent of the glandular pubescence, and the proportions of the corolla are all peculiar to this species. Also, the capsule is smaller than is usual in the genus.

Another distinct species is *A. Gonzalezii*, its cylindrical glabrous calyx-tube and ciliate calyx-lobes being different from those of every other species (pl. 17, n). The capsule characters are also unique in the genus (pl. 17, b), although the seed arrangement somewhat resembles that in *A. abditus*.

Geographical Distribution

The species of *Anisacanthus* are semi-xerophytic, usually growing on exposed, rocky slopes within a range confined almost entirely to Mexico. The center of distribution appears to be in southern Mexico, in the general region of Puebla, Oaxaca, Morelos, and the state of Mexico. Migration seems to have been mainly northward. Only three entities, *A. insignis* var. *linearis*, *A. Thurberi*, and *A. Wrightii*, extend into the United States. Representatives of the genus are found

throughout Mexico, however, and it may be anticipated that further collections will extend the present known ranges. The ranges of the species in the southern part of Mexico around the main center of distribution overlap somewhat, whereas the northern species are more distinct. There seems to be a small secondary center of distribution in the Sonoran region

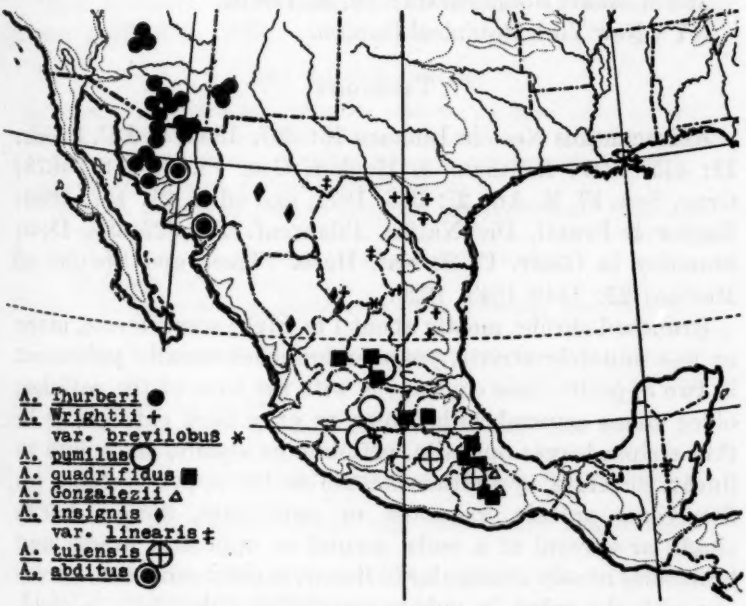

Fig. 1. The geographical distribution of the species of *Anisacanthus* in North America.

which shows a northerly migration with one species extending into Arizona and southwestern New Mexico. It is interesting to note the regions where *Anisacanthus* is absent; with the exception of the two Sonoran species one might say that it is not found on the coastal slopes or lowlands. In general, the plants of this genus are characteristic of the mountainous region of southern Mexico and the high central plateau extending northward (fig. 1).

ABBREVIATIONS

The herbaria from which material was obtained for study and from which specimens have been cited are indicated by the following abbreviations:

C = University of California, Berkeley.
F = Field Museum of Natural History, Chicago.
M = Missouri Botanical Garden, St. Louis.
NY = New York Botanical Garden.

TAXONOMY

Anisacanthus Nees in Linnaea **16**: 307. 1842; in DC. Prodr. **11**: 445. 1847; Bentham. & Hooker, Gen. Pl. **2**: 1117. 1873; Gray, Syn. Fl. N. Am. 2^1: 326. 1878, and ed. 2, 2^1: 457. 1886; Engler & Prantl, Die Natürl. Pflanzenf. 4^{3b}: 327–328. 1895; Standley in Contr. U. S. Nat. Herb. [Trees and Shrubs of Mexico] **23**: 1342–1343. 1926.

Branched shrubs, mostly about 1 m. high; stems terete, more or less minutely striate, younger branches usually pubescent in two opposite lines continuous with the base of the petioles, older stems covered with brown or gray bark exfoliating in thin strips; leaves opposite, petiolate or sessile, lanceolate to linear, punctate, cystoliths common on the upper surface; inflorescence spicate, racemose or paniculate, flowers borne singly or several at a node, secund or opposite; bracts and bracteoles mostly triangular to linear, usually caducous, agreeing with the calyx in pubescence; calyx subequally 5-lobed, lobes triangular to linear-acuminate, pubescent to glabrous; corolla usually red, mostly pilose, tubular to funnel-shaped, more or less arcuate, somewhat inflated at the base around the ovary, 2-lipped, usually recurved, the posterior lip entire or slightly emarginate, the anterior lip 3-lobed; stamens 2, epipetalous anteriorally, usually at the base of the central lobe and alternate with the corolla-lobes, filaments more or less thick and fleshy, colored, glabrous, anthers 2-celled, subequal, inserted at the same level or nearly so, parallel or slightly divergent at the base, connected to the middle or slightly below,

non-mucronate or appendaged; style filiform, glabrous, about as long as the corolla, stigma simple, 2-lobed; fruit a subpyriform capsule, slightly beaked, usually narrowed at the base to form a relatively distinct stipe, glabrous and shiny; seeds 2–4, discoid, more or less tuberculate, each supported by a curved retinaculum usually at about the same height in the body of the capsule.

Type species: **Anisacanthus quadrifidus** (Vahl) Nees in Linnaea **16**: 307. 1842.

KEY TO THE SPECIES

A. Bracts of the inflorescence foliaceous, obscuring the calyx; entire surface of the plant glandular, at least in the younger stages.....*1. A. abditus*
AA. Bracts of the inflorescence neither foliaceous nor obscuring the calyx; glands, when present, confined to the inflorescence.
B. Calyx glabrous or nearly so except for the hirsute-ciliate lobes, not glandular.....*2. A. Gonzalezii*
BB. Calyx distinctly glandular, the lobes not hirsute-ciliate.
C. Corolla 4–5 cm. long.
D. Leaves petiolate, linear-lanceolate to lanceolate, pilose to hispid .....*3. A. insignis*
DD. Leaves sessile, linear to linear-lanceolate, essentially glabrous .....*3a. A. insignis* var. *linearis*
CC. Corolla 3–4 cm. long.
D. Calyx 9–20 mm. long; stamens epipetalous below sinuses of anterior lip.....*4. A. Thurberi*
DD. Calyx 5–10 mm. long; stamens epipetalous at sinuses of anterior lip.
E. Calyx mostly 7–10 mm. long; lobes 5–6 mm. long, attenuate .....*5. A. quadrifidus*
EE. Calyx mostly 5 mm. long; lobes 1–3 mm. long, more or less acute, not alternate.
F. Calyx-tube equal to or shorter than the lobes.....*6. A. Wrightii*
FF. Calyx-tube much longer than the lobes.....*6a. A. Wrightii* var. *brevilobus*
BBB. Calyx pubescent, not glandular; the lobes not hirsute-ciliate.
C. Ultimate branches pubescent in lines; calyx 7–12 mm. long.....*7. A. pumilus*
CC. Ultimate branches evenly pubescent over entire surface; calyx 10–14 mm. long.....*8. A. tulensis*

1. **A. abditus** Brandg. in Zoe **3**: 348–349. 1893; Standl. in Contr. U. S. Nat. Herb. **23**: 1342. 1926.

Shrubs about 1–2 m. high, more or less glabrous-pubescent

throughout; leaves ovate to lanceolate, 1–6 cm. long, 0.5–3 cm. broad, petioles slender, 0.5–2.5 cm. long; bracts of the inflorescence quite distinct from the upper leaves, sessile, ovate to obspatulate, obtuse, about 1 cm. long, 4–5 mm. broad; inflorescence a terminal or lateral spike; calyx obscured by the subtending bracts, 5–7 mm. long, rather thin and delicate, deeply 5-cleft, lobes lance-attenuate; corolla 3–4 cm. long, glabrous, tubular, the 4 lobes subequal, shorter than the tube, 5 mm. broad, ovate; filaments alternate, attached near the base of the central anterior lobe, 7–9 mm. long, anthers 3 mm. long, sacs connected to below the middle; ovary extending about 1 mm. above the disc; capsule 1 cm. long, about 3 mm. in diameter, the body more or less oblong, slightly longer than the stipe; seeds 4, 2–3 mm. in diameter, tuberculate, one pair borne obliquely about 2 mm. above the other.

DISTRIBUTION: mountainous region of central Sonora, Mexico.

MEXICO: SONORA: Las Durasnillas, May 14, 1892, *Brandegee s.n.* (C TYPE, F); vicinity of Alamos, March, 1910, *Rose, Standley & Russell s.n.* (F); Carameehi, Rio Mayo, Dec. 3–10, 1934, *Gentry 1178* (F, NY, M).

2. A. Gonzalezii Greenm. in Proc. Am. Acad. **39**: 89. 1903; Standl. in Contr. U. S. Nat. Herb. **23**: 1342. 1926.

Suffruticose; stems uniformly pubescent; leaves ovate-lanceolate to linear-lanceolate, 1.5–4 cm. long, 4–17 mm. broad, puberulent or often slightly pubescent above, pilose below, petioles 1–5 mm. long, pubescent; inflorescence spicate, flowers 1–2 in each axil, sessile; bracts linear to linear-lanceolate, 0.5–2 cm. long, 1–3 mm. broad, finely pubescent, ciliate; calyx 5–11 mm. long, tube cylindrical, glabrous, lobes lance-attenuate, hirsute-ciliate, about as long as the tube; corolla 3.5–4 cm. long, slightly infundibuliform, posterior lip emarginate, lobes about one-third total length of the corolla, ligulate, slightly recurved; stamens attached near the base of the anterior lip and alternate with the lobes, filaments 11–13 mm. long, anther-sacs 4 mm. long, parallel, connected to below the middle; ovary extending about 1.5 mm. above the disc; capsule 16–19 mm. long, 3–4 mm. in diameter, gradually tapering to the base; seeds 4, 3–4 mm. in diameter, one pair borne obliquely above the other.

DISTRIBUTION: central and northern Oaxaca, Mexico.

MEXICO: OAXACA: Las Naranjas, Aug., 1908, *Purpus 3018* (C), and *3041* (F, M, NY).

3. A. insignis Gray, Syn. Fl. N. Am. ed. 2, 2^1: 457. 1886; Standl. in Contr. U. S. Nat. Herb. **23**: 1343. 1926.

Pl. 18, fig. A.

Drejera puberula Torr. in U. S. & Mex. Bound. Surv. Bot. 123. 1859, in part.

Anisacanthus pumilus Wats. in Proc. Am. Acad. **18**: 133. 1883, in part, not Nees in DC. Prodr. **11**: 445. 1847.

Slender, vine-like shrub, 1.5–2.5 m. high; stems pubescent in lines; lower leaves lanceolate to ovate, 2.5–7 cm. long, 1–3 cm. broad, slightly acuminate, puberulent, pilose to tomentose, petioles 3–20 mm. long, tomentose; flowers borne in short racemose clusters in the axils of fallen leaves; bracts and bracteoles puberulent, sometimes glandular, obovate, elliptic or ovate, reduced from about 10 mm. to about 2 mm. in length; pedicels 3–8 mm. long, glandular; calyx 6–10 mm. long, stipitate-glandular, lobes separate almost to the base, linear-ligulate, somewhat attenuate; corolla mostly 5 cm. long, curved, slightly infundibuliform, lobes linear, recurved, longer than the tube; stamens alternate, inserted at the base of the central anterior lobe, anthers 4 mm. long, anther-sacs parallel, slightly oblique; disc at base of ovary about 1 mm. high; capsule 2 cm. long, stipe as long as or longer than the body; seeds 4, sometimes 1 or 2 aborted, about 5 mm. in diameter, slightly obliquely discoid, brown, more or less tuberculate.

DISTRIBUTION: central Mexican plateau region from Durango to Coahuila and Chihuahua.

MEXICO: CHIHUAHUA: gravelly banks along the Cibolo of the Rio Grande, May–June, *Bigelow s.n.* (NY); valley of the Rio Conchos below Santa Rosalia, April 21, 1847, *Gregg 504* (M, NY); vicinity of Chihuahua, alt. 1300 m., April 8–27, 1908, *Palmer 51* (F, M, NY); rocky hills near Chihuahua, March 23 & April 17, 1885, *Pringle 268* (F, M, NY); Bachimba Canyon, April 2, 1886, *Pringle 862* (C, F, M, NY); Santa Rosalia, south of Chihuahua, April 30, 1847, *Wislizenus 267* (M). COAHUILA: Valley of Parras, April 11, 1847, *Gregg 407* (M); Parras, June 8–28, 1880, *Palmer 1017* (F, NY), and Oct. 6–11, 1898, *430* (C, F, M, NY); Parras, Feb.–March, 1905, *Purpus 1046* (C, F, M, NY); Sierra de Parras, Oct., 1910, *Purpus 4752* (C, F, M). DURANGO: City of Durango and vicinity, April–Nov., 1896, *Palmer 25* (C, F, M, NY); Pueblita, April 11, 1900, *Trelease 75* (M).

3a. A. insignis Gray var. **linearis** Hagen, var. nov.[7]

Pl. 18, fig. B.

Lower leaves and those of the flowering branches sessile, linear to linear-lanceolate, 1–4 cm. long, 1–5 mm. broad, essentially glabrous.

DISTRIBUTION: southwestern Texas and northern Mexico.

TEXAS: CHISOS MOUNTAINS, BREWSTER CO.: lower end of Juniper Canyon, alt. 1158–1219 m., July 15–18, 1921, *Ferris & Duncan 2990* (M, NY); dry creek bed, lower Blue Creek Canyon, alt. 1370 m., June 23, 1931, *Moore & Steyermark 3202* (C, M TYPE, NY); Aug. 2, 1931, *Mueller 8166* (F, M); rocky cliffs and ledges, Oak Canyon, May 24, 1928, *Palmer 34148* (M, NY).

MEXICO: COAHUILA: near the northern entrance of El Puerto de San Lazaro, June 16, 1936, *Wynd & Mueller 106* (M).

4. A. Thurberi (Torr.) Gray, Syn. Fl. N. Am. **2**[1]: 328. 1878, and ed. 2, **2**[1]: 457. 1886; Hemsl. Biol. Centr.-Am. Bot. **2**: 522. 1882; Woot. & Standl. in Contr. U. S. Nat. Herb. **19**: 597. 1915; Standl. in Contr. U. S. Nat. Herb. **23**: 1342. 1926.

Drejera Thurberi Torr. in U. S. & Mex. Bound. Surv. Bot. 124. 1859.

Drejera puberula Torr. *Ibid.* 123.

Low shrub, 0.5–1.5 m. high; stem pubescence reduced to a few scattered hairs in two opposite lines; leaves lanceolate, mostly 3–5 cm. long, 7–15 mm. broad, hispid to glabrate, petioles 1–5 mm. long; flowers borne singly in the axils of the bract-like upper leaves, or in 2–5-flowered greatly foreshortened axillary racemose clusters; bracts and bracteoles lanceolate to linear, acute, mostly 2–10 mm. long, 1–3 mm. broad, puberulent, often slightly pilose along the midrib and margin; pedicels 3–7 mm. long, glandular; calyx .9–2 cm. long, deeply 5-cleft, stipitate-glandular, puberulent, with few pilose hairs scattered throughout, lobes linear-attenuate, more or less tentacular; corolla dull red, 3.5–4 cm. long, tube funnelform, lobes shorter than the tube, ovate, obtuse, divergent but scarcely recurved, upper lip slightly emarginate; stamens

[7] **Anisacanthus insignis** Gray var. **linearis**, var. nov., *A. insigni* similis, sed foliis inferioribus sessilibus linearibus vel lineari-lanceolatis, 1–4 cm. longis, 1–5 mm. latis, glabris differt.

epipetalous, inserted below the sinuses of the anterior lip, filaments about 2 cm. long, anther-sacs 3–4 mm. long, equal, parallel, connected to below the middle; capsule about 15–18 mm. long, about 6 mm. in diameter, stipe shorter than the subovoid body; seeds 2, slightly tuberculate, about 5 mm. in diameter.

DISTRIBUTION: from southern Sonora in Mexico northward along the western mountainous slopes into central Arizona, and eastward into the southwestern part of New Mexico.

UNITED STATES: ARIZONA: near creek, Rhoda Riggs' Ranch, Chiricahua Mts., alt. 1676 m., Oct. 22, 1906, *Blumer 1304* (F, M, NY); Box Canyon, Chiricahua Mts., alt. 1676 m., July 9, 1907, *Blumer 1248* (F, M, NY); Nogales, May, 1892, *Brandegee s.n.* (C); Fort Whipple, on gravelly hillsides, May 3, 1865, *Coues & Palmer 190-c* (M); 40 miles south of Fort Whipple, Aug. 5, 1865, *Coues & Palmer 130* (M); 5 miles west of Tucson, in Tucson Mts., March 7, 1934, *Detwiler 47* (F); Douglas, rocky draws and washes, May, 1907, *Goodding 2232* (C, M); dry, rocky hillsides 5 miles northeast of Rodeo, June 16, 1930, *Goodman & Hitchcock 1153* (C, F, M, NY); Rincon Pass, Oct. 19, 1900, *Griffiths 2018* (NY); Sabenio Cañon, March 30, 1901, *Griffiths 2595* (NY); Santa Ritas, foot of Old Baldy, April, 1901, *Griffiths 2652* (NY); Roadside Mine, Pima County, April 21, 1932, *Harrison & Kearney 8528* (F); hills along the Rio San Pedro, Sept. 9, 1858, *Hayes 598* (NY); Congress Junction, alt. 91 m., May 4, 1903, *Jones s.n.* (M); Cave Creek Canyon, Chiricahua Mts., 1829–2438 m., June 26–29, 1927, *Kusche s.n.* (F); Santa Catalina Mts., April, 1881, *Lemmon s.n.* (C); south of Bisbee, Mexican boundary line, Oct. 3, 1892, *Mearns 1024* (C, M, NY); Patagonia, May 6, 1902, *Orcutt s.n.* (C); 1869, *Palmer s.n.* (NY); Tucson, April, 1884, *Parish s.n.* (M), and May 25, 1884, *195* (F); Sierra Tucson, April 25, 1884, *Parish s.n.* (NY); Tucson, April, 1884, *Parish & Parish s.n.* (C); Picacho Mts., March 23, 1930, *Peebles 6473* (NY); Santa Catalina Mts., April 18, 1881, *Pringle s.n.* (F), and June, 1882, *s.n.* (M, NY); Sierra Tucson, April 25, 1884, *Pringle s.n.* (F), and June 1, 1884, *4332* (F, NY); Tucson, in arroyo, April 15, 1901, *Shear 4231* (NY); Tucson, date lacking, *Spring s.n.* (C); west of Sonoita, alt. 1433 m., April 18, 1934, *Stone 39* (NY); Stone Cabin Canyon, Santa Rita Mts., alt. 1524 m., May 23, 1903, *Thornber 294* (C, M); foothills of Tucson Mts., alt. 762 m., May 9, 1903, *Thornber 474* (C); Ft. Huachuca, May, 1892, *Wilcox s.n.* (NY), and 1894 (M).

NEW MEXICO: along the Gila River and mesa between cliff and upper canyon of Gila, Grant Co., alt. 1300–1350 m., July 25, 1920, *Eggleston 16794* (M); Mangas Canyon, May and June, 1880, *Greene s.n.* (NY), June 1, and July 3, 1880, *s.n.* (F), and June and July, 1880, *12502* (M); Dog Spring, Grant Co., May 26, 1892, *Mearns 113* (NY); Mangas Springs, 18 miles northwest of Silver City, alt. 1453 m., June 9, 1903, *Metcalfe 113* (C, M, NY); on the upper Rio Grande, below El Paso, 1851–1852, *Wright 1456* (M, NY).

MEXICO: SONORA: San Miguel de Horcasitas, May, 1892, *Eisen s.n.* (C); San Bernardo, Rio Mayo, Feb. 16, 1935, *Gentry 1309* (F, M, NY); El Alamo, Magdalena, May 25, 1925, *Kennedy 7107* (C); Torres, Jan.–March, 1902, *Purpus 409* (C, M).

5. A. quadrifidus (Vahl) Nees in Linnaea **16**: 307. 1842; Standl. in Contr. U. S. Nat. Herb. **23**: 1343. 1926.

Justicia coccinea Cav. Ic. Pl. **2**: 77, *pl. 199*. 1793, not Aublet.

Justicia quadrifida Vahl, Enum. Pl. **1**: 124. 1805.

Justicia virgularis Salisb. Parad. Lond. *pl. 50*. 1806.

(?) *Justicia superba* Hort. ex Nees in DC. Prodr. **11**: 445. 1847.

Anisacanthus virgularis (Salisb.) Nees in DC. Prodr. **11**: 445. 1847; Hemsl. Biol. Centr.-Am. Bot. **2**: 522. 1882; Gray, Syn. Fl. N. Am., ed. 2, **2**[1]: 457. 1886.

Younger branches green, somewhat purplish, pubescent in two opposite lines; leaves short-petiolate to subsessile, linear to lanceolate, long-acuminate, 2–5 cm. long, 3–13 mm. broad, glabrous except for minute pubescence at base and along midrib above, punctate, the upper leaves much reduced; inflorescence spicate, secund, flowers sessile to short-pedicillate, almost always solitary, rarely 2 in the axils of the upper bracts; bracts and bracteoles lanceolate, glandular, ciliate, 3–4 mm. long, caducous; calyx glandular, 6–10 mm. long, deeply 5-cleft, lobes ciliate, lance-acuminate, 5–6 mm. long at anthesis; corolla scarlet, 3.5–4 cm. long, slightly curved, scarcely dilated at the throat, lobes recurved, ligulate, about as long as the tube; stamens inserted at the sinuses of the anterior lip, anthers 3–4 mm. long, anther-sacs equal or nearly so, parallel; capsule 15–18 mm. long, stipe as long as the body; seeds 4, subdiscoid, about 5 mm. in diameter, more or less tuberculate.

DISTRIBUTION: central Oaxaca, Mexico, northward into Puebla, Hidalgo and Queretaro, and westward into San Luis Potosi and Zacatecas.

MEXICO: HIDALGO: Ixmiquilpan, July, 1905, *Rose, Painter & Rose 8944* (F, M, NY); OAXACA: Vallè de Oaxaca, alt. 1600 m., Nov. 8, 1906, *Conzatti 1519* (F); Las Naranjas, Aug., 1908, *Purpus 3018* (F, M, NY); Oaxaca Valley, alt. 1524 m., Nov. 7, 1894, *Smith 731* (M, NY); PUEBLA: vicinity of Puebla, Acatzinco, District of Tepeaca, alt. 2110 m., July, 1907, *Arsène & Amable 3567* (M, NY), and Aug., 1907, *1568* (M); Tehuacan, Dec., 1892, *Liebmann 10600* (F); Acatzinco, Nov., 1909, *Nicolas 35* (F); valley near Tehuacan, alt. 1524 m., Aug. 5, 1901, *Pringle 9390* (F, M); Tehuacan, Sept., 1911, *Purpus 5669* (C); near El Riego, Tehuacan, Sept., 1905, *Rose, Painter & Rose 10033* (F, M); QUERETARO: near San Juan del Rio, Aug. 17, 1905, *Rose, Painter & Rose 9515* (NY); same locality, Nov., 1827, *Berlandier 1237* (NY); SAN LUIS POTOSI: Dec. 27, 1848, *Gregg 578* (M); 1878, *Parry & Palmer 706* (F); gravel washes, Bocas, Aug. 17, 1891, *Pringle 3820* (C,

F, NY); region of San Luis Potosi, 1879, *Schaffner 367* (F, NY); ZACATECAS: city of Zacatecas, 1908, *Lloyd 10* (F).

Besides the above, several authentic collections from European gardens have been examined. Although data accompanying them are usually quite incomplete, they have been of importance in establishing the identity of this species.

6. **A. Wrightii** (Torr.) Gray, Syn. Fl. N. Am. 2^1: 238. 1878, and ed. 2, 2^1: 457. 1886; Hemsl. Biol. Centr.-Am. Bot. **2**: 522. 1882; Standl. in Contr. U. S. Nat. Herb. **23**: 1343. 1926.

Drejera Wrightii Torr. in U. S. & Mex. Bound. Surv. Bot. 123. 1859.

Drejera juncea Torr. *Ibid.* 124.

Anisacanthus junceus (Torr.) Hemsl. Biol. Centr.-Am. Bot. **2**: 522. 1882.

Young branches dull green, pubescent in two lines; lower leaves broadly lanceolate, 1–5 cm. long, 0.5–2 cm. broad, hispid to glabrate, petioles 3–10 mm. long, pilose; flowers usually borne singly or in pairs in secund, terminal, spicate inflorescences, subsessile to short-pedicellate; bracts and bracteoles lanceolate-acuminate, 2–5 mm. long, puberulent; calyx about 0.5 cm. long, puberulent, glandular, lobes ovate to lanceolate, 2–3 mm. long, acute, few, scattered hairs along margin and at tip; corolla 3–4 cm. long, lobes narrowly ovate, obtuse, posterior lobe slightly emarginate, tube slender, nearly straight, scarcely dilated at the throat, longer than the lobes; stamens epipetalous, inserted near the sinuses of the central anterior lobe, filament about 1 cm. long, anthers 3 mm. long, anther-sacs connected nearly half their length from the tips; ovary extending about 2 mm. above the disc; capsule about 15 mm. long, body about 6 mm. thick, shorter than the stipe; seeds 2, rarely 4, about 5 mm. in diameter.

DISTRIBUTION: mostly along the eastern part of the central plateau region of Mexico, in the states of Tamaulipas, Nuevo Leon, and Coahuila. It has been found at one station in northern Michoacan, and from several localities in Bexar, Uvalde, and Kinney counties in Texas.

UNITED STATES: TEXAS: Fort Clark, June–July, 1857, *Blake s.n.* (NY); San Antonio, Bexar Co., tropical life zone, June 27, 1911, *Clemens & Clemens s.n.* (F, M); Concan, Uvalde Co., along rocky creeks, June 15, 1916, *Palmer 10212*

(M); valley of the Rio Grande below Donana, *Parry, Bigelow, Wright & Schott s.n.* (NY); rocky banks along the Rio Frio, June, 1884, *Reverchon 1580* (F, M, NY); same locality, *Schott s.n.* (F), and Oct. 19, 1851, *733* (NY); Uvalde Co., growing along railroad, June 30, 1929, *Schultz 3057* (F); May–Oct., 1849, *Wright 435* (M, NY TYPE).

MEXICO: COAHUILA: La Pena, Nov., 1852, *Thurber 849* (NY TYPE of *Drejera juncea* Torr.); MICHOACAN: Morelia, Dos Tetecos, March 7, 1911, *Arsène 36* (F); NUEVO LEON: Monterrey, Guadalupe, alt. 540 m., June, 1911, *Arsène & Abbot 6228* (M); Monterrey, damp rich soil in thickets, *Edwards & Eaton s.n.* (NY); by streams, El Carrizo, alt. 427 m., June 16, 1906, *Lozano 10256* (C, F, M, NY); arroyos of mesas near Monterrey, July 23, 1888, *Pringle 1891* (C, F, NY); valley of Monterrey, June 17, 1889, *Pringle 2710* (C, F, M), and Aug. 19, 1903, *11663* (F); TAMAULIPAS: La Vegonia, vicinity of San Jose, alt. 823 m., July 20, 1930, *Bartlett 10526* (F); La Tamaulipeca, vicinity of San Miguel, July 27, 1930, *Bartlett 10670* (F); vicinity of Victoria, alt. 320 m., Feb. 1–April 9, 1907, *Palmer 120* (C, F, M, NY).

The specimens of Lozano and Bartlett are atypical, having calyces very nearly like those of *A. quadrifidus*. Thurber's specimen, which Torrey called *Drejera juncea*, is somewhat like the two above, but judging mainly by the glandular characters, general size of the calyx and of the anthers, its relationship is evidently with *A. Wrightii* rather than *A. quadrifidus*.

6a. A. Wrightii (Torr.) Gray var. **brevilobus** Hagen, var. nov.[8]

Lower leaves subsessile, lanceolate to linear-lanceolate, 1.5–4 cm. long, 3–8 mm. broad, glabrate; calyx 4–5 mm. long, the tube several times longer than the triangular, acute lobes.

DISTRIBUTION: northern Mexico, known only from the type locality.

MEXICO: COAHUILA: Chojo Grande, 27 miles southeast of Saltillo, July 16, 1905, *Palmer 719* (C, F, M TYPE, NY).

This variety is quite distinct on account of the short, triangular, acute calyx-lobes, and the narrower, subsessile leaves.

7. A. pumilus (Dietr.) Nees in DC. Prodr. **11**: 445. 1847; Gray, Syn. Fl. N. Am., ed. 2, **2**[1]: 457. 1886; Hemsl. Biol. Centr.-Am. Bot. **2**: 522. 1882; Standl. in Contr. U. S. Nat. Herb. **23**: 1342. 1926.

[8] **Anisacanthus Wrightii** (Torr.) Gray var. **brevilobus**, var. nov., foliis inferioribus subsessilibus lanceolatis vel lineari-lanceolatis, 1.5–4 cm. longis, 3–8 mm. latis, glabris; petiolis 1–2 mm. longis; calyce 4–5 mm. longo, lobis tubo brevioribus, triangularibus, acutis.

Justicia pumila Dietr. in Vollst. Lex. Gärtn. Nachtr. **4**: 197. 1818.

Drejera Greggii Torr. in U. S. & Mex. Bound. Surv. Bot. 124. 1859.

Anisacanthus Greggii (Torr.) Gray, Syn. Fl. N. Am. **2**[1]: 328. 1878.

Shrub, 2.5–3 m. high; stem dark brown, pubescent in two opposite decussating lines; leaves ovate-lanceolate to linear-lanceolate, 2–3 cm. long, 3–10 mm. broad, hispid, subsessile to short-petiolate; flowers in compact racemose clusters of from one to several borne in the axils of fallen leaves; bracts and bracteoles about 2 mm. long, puberulent, ciliate, acute; calyx short-pedicellate, about 7–12 mm. long, puberulent, pilose, deeply and subequally 5-lobed, the lobes about 6–9 mm. long, acute; corolla 4–5 cm. long, bright red, thinly pilose, slender, curved, slightly dilated at the throat, the linear-ligulate lobes longer than the tube, recurved; stamens inserted near the base of the central lobe of the anterior lip, anther-sacs 4 mm. long, nearly equal, parallel, connected about half way to the base; capsule about 2 cm. long, body 5–6 mm. thick, as long as the stipe; seeds 4, about 5 mm. in diameter, slightly tuberculate.

DISTRIBUTION: northern Michoacan to San Luis Potosi, and northwestward along the plateau region to southern Chihuahua.

MEXICO: Gonzales Junction, April, 1910, *Rusby s.n.* (NY); MICHOACAN: vicinity of Morelia, Quinceo, alt. 1900 m., March 11, May 25, 1909, *Arsène 2778* (M), and July 18, 1909, *s.n.* (NY); hills east of Zipimeo, May 11, 1849, *Gregg 810* (M); GUANAJUATO: Silao, July, 1903, *Purpus 140* (C); SAN LUIS POTOSI: in the region of San Luis Potosi, 22° N. Lat., alt. 1829–2434 m., 1878, *Parry & Palmer 706½* (M); CHIHUAHUA: battleground of Paso del Gallinero, near Dolores, Dec. 29, 1848, *Gregg 587* (NY TYPE of *Drejera Greggii* Torr., M).

8. A. tulensis Greenm. in Field Mus. Publ. Bot. Ser. **2**: 343. 1912.

Justicia superba Sessè & Moçiño, Pl. Nov. Hisp., ed. 2, p. 3. 1893, in part; not *J. superba* Hort. ex Nees in DC. Prodr. **11**: 445. 1847, in synonymy.

Ultimate branches tomentose to pilose over entire surface; leaves lanceolate to linear-lanceolate, 1.5–5 cm. long, 4–20 mm. broad, puberulent above, sparsely pubescent below, mostly

along the veins and margins, petioles 1–7 mm. long, tomentose to pilose; inflorescence mostly secund, racemose, usually not more than 2 flowers maturing in a cluster; bracts linear-lanceolate, 5–10 mm. long, puberulent, ciliate, bracteoles similar but smaller, both bracts and bracteoles caducous; pedicels 1–5 mm. long, tomentose to pilose, puberulent; calyx puberulent, tomentose to sparsely pilose, 10–14 mm. long, lobes lanceolate, as long as the tube or slightly longer; corolla 5–5.5 cm. long, finely pilose, tube slender, arcuate, about 2 cm. long, lobes linear-ligulate, recurved, distinctly longer than the tube, posterior lip slightly emarginate; stamens alternate, inserted near the base of the central lobe of the anterior lip, filaments 18–25 mm. long, anthers 4 mm. long, anther-sacs subequal, slightly oblique, connected almost half their length from the tip; capsule 17–25 mm. long, about 5–8 mm. thick, stipe longer than the body; seeds 4, subdiscoid, 5–6 mm. in diameter, tuberculate.

DISTRIBUTION: southern Mexico.

MEXICO: OAXACA: Santa Maria del Tule, alt. 1600 m., March 31, 1907, *Conzatti 1773* (F TYPE); MORELOS: Ayacapixtla, 1787–1795–1804, *Sessé & Moçiño 293* in part, and *373* (F).

EXCLUDED SPECIES

Anisacanthus glaberrimus Jones in Contr. West. Bot. No. 15: 151. 1929 = (?) **Odontonema.**

LIST OF EXSICCATAE

Arsène, G. *36* (6), —, *2778* (7).
Arsène, G. & Bro. Abbot. *6228* (6).
Arsène, G. & Bro. Amable. *1568, 3567* (5).
Bartlett, H. H. *10526, 10670* (6).
Berlandier, J. *1237* (5).
Bigelow, J. M. — (3).
Blake, S. F. — (6).
Blumer, J. C. *1248, 1304* (4).
Brandegee, T. S. — (1), — (4).
Clemens, Mr. & Mrs. Joseph. *1065* (6).
Conzatti, C. *1519* (5), *1773* (8).
Coues, Elliott & Edward Palmer. *130, 190-c* (4).
Detwiler, S. B. *47* (4).
Edwards, Dr., & Maj. Eaton. — (6).
Eggleston, W. W. *16794* (4).
Eisen, G. — (4).
Ferris, Roxana S. & C. D. Duncan. *2990* (3a).
Gentry, Howard Scott. *1178* (1), *1309* (4).
Goodding, Leslie N. *2232* (4).
Goodman, George J. & C. Leo Hitchcock. *1153* (4).
Greene, Edward Lee. —, —, *12502* (4).
Gregg, J. *407, 504* (3), *578* (5), *587, 810* (7).

Griffiths, David. *2018, 2595, 2652* (4).
Harrison, G. H. & T. H. Kearney. *8528* (4).
Hayes, Sutton. *598* (4).
Jones, Marcus E. — (4).
Kennedy, P. B. *7107* (4).
Kusche, J. Aug. — (4).
Lemmon, J. G. — (4).
Liebmann, F. M. *10600* (5).
Lloyd, Francis E. *10* (5).
Lozano, F. L. *10256* (6).
Mearns, Edgar A. *113, 1024* (4).
Metcalfe, O. B. *113* (4).
Moore, John Adam & Julian Steyermark. *3202* (3a).
Mueller, Cornelius H. *8166* (3a).
Nicolas, —, *35* (5).
Orcutt, C. R. — (4).
Palmer, Edward. *25, 51, 430, 1017* (3), — (4), *120* (6), *719* (6a).
Palmer, Ernest J. *10212* (6), *34148* (3a).
Parish, W. F. *195* (4).
Parish, Samuel B. & W. F. — (4).
Parry, C. C., J. M. Bigelow, Charles Wright & A. Schott. — (6).
Parry, C. C. & Edward Palmer. *706* (5), *706½* (7).
Peebles, R. H. *6473* (4).
Pringle, C. G. *268, 862* (3), —, —, —, *4832* (4), *1891, 2710, 11663* (6), *3820, 9390* (5).
Purpus, C. A. *140* (7). *409* (4), *1046, 4752* (3), *3018, 3041* (2), *3018, 5669* (5).
Reverchon, J. *1580* (6).
Rose, J. N., Joseph H. Painter & J. S. Rose. *8944, 9515, 10033* (5).
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Schaffner, J. G. *367* (5).
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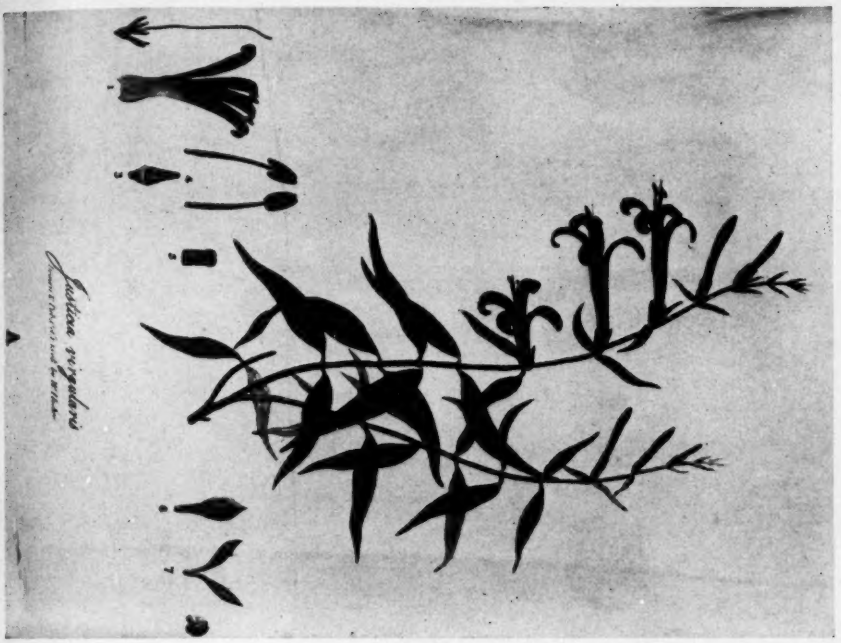
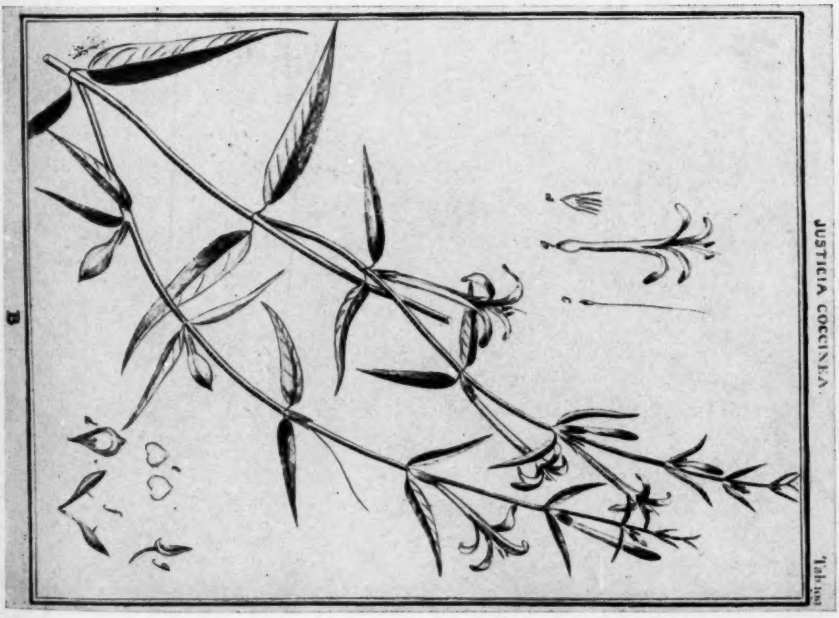
Explanation of Plate

PLATE 16

A. From Salisbury, 'Paradisus Londinensis,' *pl. 50.* 1806, illustrating *Justicia virgularis* Salisb., which equals *Anisacanthus quadrifidus* (Vahl) Nees.

B. From Cavanilles, 'Icones et Descriptiones Plantarum,' *pl. 199.* 1793, illustrating *Justicia cocoinea* Cav., which equals *Anisacanthus quadrifidus* (Vahl) Nees, the type species of the genus.




JUSTICIA COCCINEA.
Tab 1061

EXPLANATION OF PLATE

PLATE 17

a. Anther of *Anisacanthus quadrifidus* × 5.
b. Dehisced capsule of *Anisacanthus Gonzalezii* showing position of seeds, × 1.4.
c. Single valve of the capsule of *Anisacanthus abditus* inner-face view, × 1.4.
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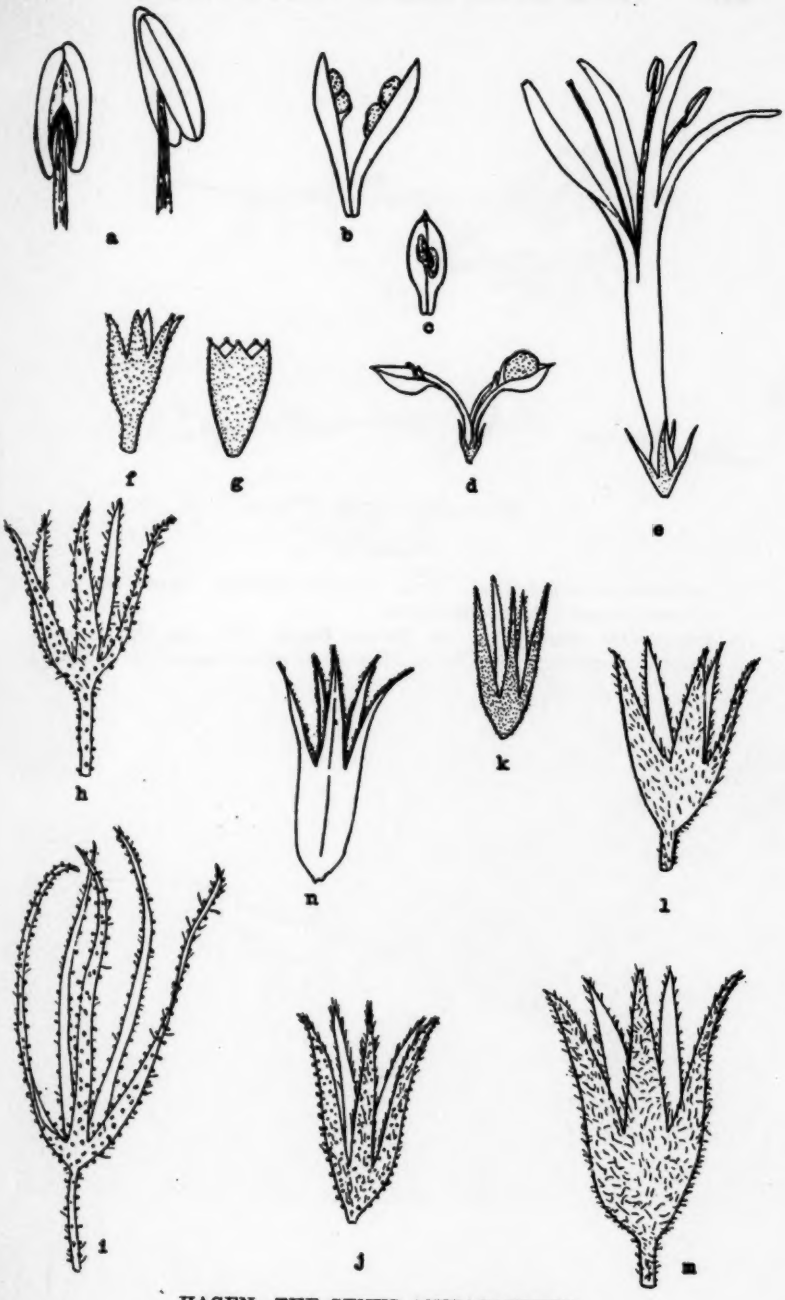
m. Calyx of *Anisacanthus tulensis* × 3.5.
n. Calyx of *Anisacanthus Gonzalezii* × 3.5.



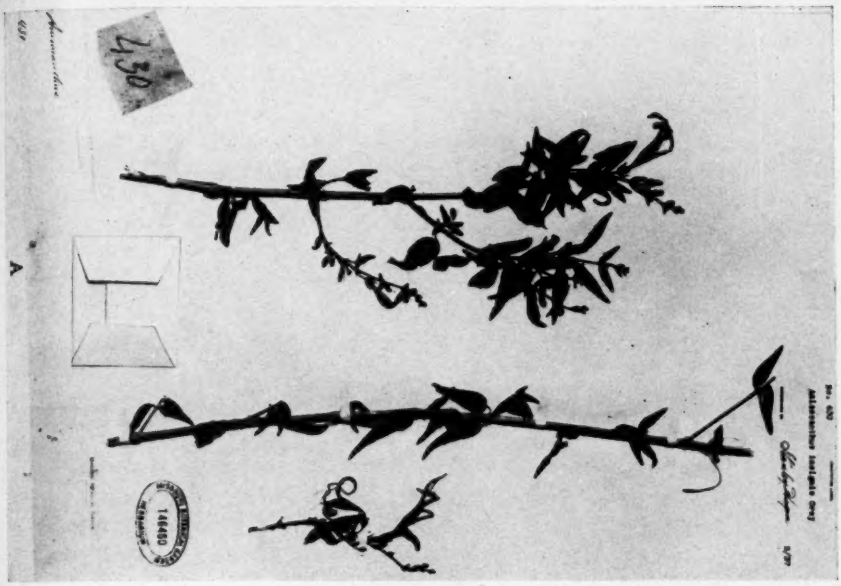
HAGEN—THE GENUS ANISACANTHUS

Explanation of Plate

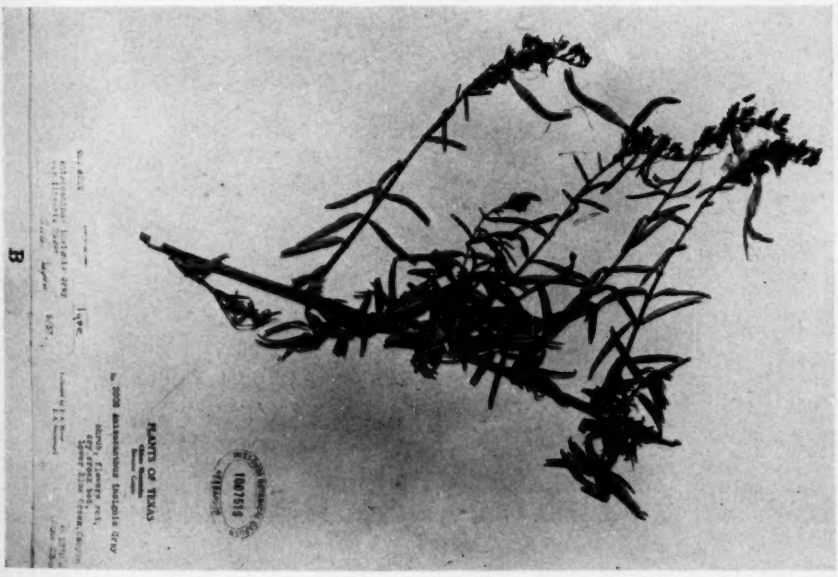
PLATE 18

A. *Anisacanthus insignis* Gray. From a typical specimen, *Palmer 430*, in the Missouri Botanical Garden Herbarium.

B. *Anisacanthus insignis* Gray var. *linearis* Hagen. From the type collection, *Moore & Steyermark 3202*, in the Missouri Botanical Garden Herbarium.



A



B

CONTRIBUTIONS TOWARD A FLORA OF PANAMA[1]

V. Collections chiefly by Paul H. Allen, and by Robert E. Woodson, Jr. and Robert W. Schery

ROBERT E. WOODSON, JR.
Assistant Curator of the Herbarium, Missouri Botanical Garden
Assistant Professor in the Henry Shaw School of Botany of Washington University
AND ROBERT W. SCHERY
Assistant in the Henry Shaw School of Botany of Washington University

LYCOPODIACEAE
(W. R. Maxon, Washington, D. C.)

Lycopodium Hoffmanni Maxon—CHIRIQUÍ: Casita Alta to Cerro Copete, alt. 2300–3300 m., July 10, 1940, *Woodson & Schery 364.* New to Panama. Known previously only from Volcan Barba, Costa Rica, at 2500–2800 m.

Lycopodium orizabae Underw. & Lloyd—CHIRIQUÍ: Casita Alta to Cerro Copete, alt. 2300–3300 m., July 10, 1940, *Woodson & Schery 365.* New to Panama. Heretofore known only from Orizaba, Mexico, and a single collection from Estrella, Costa Rica *(Stork 1959).*

POLYPODIACEAE
(W. R. Maxon, Washington, D. C.)

Elaphoglossum revolutum (Liebm.) Moore—CHIRIQUÍ: vicinity of Boquete, alt. 1200–1500 m., July 24–26, 1940. New to Panama. The specimens agree closely with type material collected in Mexico by Liebmann and with Cuban and Hispaniola specimens, of which a good series is at hand. *Elaphoglossum rampans* (Baker) Christ, founded on Wright's no. *3959,* from Cuba, is synonymous.

TAXACEAE
(P. C. Standley, Chicago)

Podocarpus **Allenii** Standl., sp. nov. Arbor excelsa 35 m. alta et ultra, trunco basi 1.5 m. diam., ramulis brevibus crassis sat

[1] Issued November 27, 1941.

dense foliatis; gemmae parvae vix ad 2 mm. longae, perulis crasse coriaceis apice rotundatis; folia alterna rigida coriacea anguste lanceolata, adulta 3.5–4.5 cm. longa 7–8 mm. lata, apicem rigidum fere spiniformem versus sensim attenuata, basi acuta et sessilia, costa supra prominente vel prominula, apicem versus minus prominente, subtus vix prominula saepius fere plana; caetera ignota.—PANAMÁ: moist upper region of Cerro Campana, alt. about 1000 m., April 21, 1941, *Allen 2437* (Herb. Field Mus., TYPE), *2424* (seedling); COCLÉ: hills north of El Valle de Antón, vicinity of La Mesa, alt. about 1000 m., Jan. 21, 1941, *Allen 2298*.

The collector's notes regarding the tree are as follows: "For nearly a year I have been picking up seedlings of this tree, anywhere from 45 cm. to 3.5 meters tall. They are everywhere in the hills above Campana, and north of El Valle, at elevations of 600 to perhaps 960 meters. Finally the mature trees have been located on Cerro Campana. The trees are about 33–36 meters tall, without branches for 18–21 meters. The huge columnar trunk is fully 1.5 meters in diameter, and covered with reddish brown, fissured bark somewhat resembling that of the California redwood."

It is with considerable diffidence that the writer proposes this new species of *Podocarpus*, although it seems to be quite as distinct as a good many other species that have been proposed in the genus. One might expect the Panama tree to be identical with *P. oleifolius* Don, common in the nearby mountains of Costa Rica, and extending southward to Peru. In Costa Rica the genus is confined, however, to the higher mountains, at 1400 to 3000 meters, and mostly at 2000 meters or more. *P. oleifolius* may be distinguished at once from *P. Allenii* by the fact that the costa is impressed rather than elevated on the upper leaf surface. So far as may be judged from leaf characters, *P. Allenii* is more closely related to *P. guatemalensis* Standl., of Guatemala and British Honduras, which also has the costa prominent upon the upper surface. *P. guatemalensis*, likewise, occurs at low elevations, descending to sea-level.

It is possible that ultimately *P. Allenii* will have to be combined with *P. guatemalensis*, but it is to be expected that flowers and fruit may furnish better characters for separating it. The adult leaves of the Panama tree are so much smaller than those of the northern one that it is believed by the writer that two distinct species are involved. The seedling leaves of *P. Allenii* are lance-linear, 9–12 cm. long, and 9–14 mm. wide. Mr. Allen states that the local name of this tree is *Cuahau*.

ERIOCAULACEAE

(H. N. Moldenke, New York)

TONINA FLUVIATILIS Aubl.—CHIRIQUÍ: vicinity of Boquete, alt. 1200–1500 m., July 24–26, 1940, *Woodson & Schery 752*. Known to occur from Cuba and British Honduras to Colombia, Trinidad and Brazil, but has not previously been collected in Panama.

BROMELIACEAE

(L. B. Smith, Cambridge, Mass.)

AECHMEA **Allenii** L. B. Smith, spec. nov. (pl. 19), acaulis, stolonibus robustissimis procreans; foliis subfasciculatis, erectis, 6–7 dm. longis, inflorescentiam multo superantibus, utrinque lepidibus minutis peradpressis obtectis, vaginis magnis, anguste ellipticis, integris, quam laminis haud atrioribus, laminis ligulatis, late acutis et mucronatis, basi nullo modo angustatis, ad 55 mm. latis, dense serrulatis, viridibus, concoloribus; scapo gracili, ad 35 cm. alto, albido-flocculoso; scapi bracteis magnis, erectis, dense imbricatis, oblanceolatis, acutis, membranaceis, pulchre roseis, ad apicem versus denticulatis, basi flocculosis; inflorescentia erecta, simplicissima, densissime ellipsoidea, 8–10 cm. longa, 4 cm. diametro; bracteis florigeris erectis, inferioribus eis scapi similibus et flores multo superantibus, supremis anguste lanceolatis, acuminatis, integris, sepala aequantibus vel quam eis paulo brevioribus; floribus sessilibus; sepalis liberis, valde asymmetricis, mucro erecto ad 6 mm. longo incluso ad 23 mm. longis, cum ovario dense albido-lepidotis; petalis delapsis solum cognitis, ca. 3 cm. longis, basi ligulis binis dentatis auctis, albis vel pallide lilacinis [! Allen]; ovario orbiculato, valde compresso et triangulato, ad 17 mm.

longo, tubo epigyno crateriformi, placentis interno loculorum angulo prope apicem affixis, ovulis caudatis.—COCLÉ: epiphytic, vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., May 12, 1941, *P. H. Allen 2378* (U. S. Nat. Herb., TYPE; Gray Herb. and Herb. Missouri Bot. Garden, photograph); trail to Las Minas, north of El Valle de Antón, alt. 1000 m., May 10, 1941, *P. H. Allen 2467* (U. S. Nat. Herb.).

The very showy rose scape-bracts of *Aechmea Allenii* are suggestive of *Ae. Mariae-Reginae,* but the large long-mucronate sepals and the large serrulate lower floral bracts immediately set it apart from this and all related species.

AECHMEA TONDUZII Mez & Pittier—DARIEN: epiphytic, rain forest, Cana-Cuasi Trail, near Camp 2, Chepigana District, alt. 1650 m., March 12, 1940, *M. E. & R. A. Terry 1529* (Herb. Field Mus.); epiphytic, rain forest, Cana-Cuasi Trail near crest, Chepigana District, alt. 1500 m., March 15, 1940, *M. E. & R. A. Terry 1592* (Herb. Field Mus.). Previously known from Costa Rica; identified by description.

AECHMEA VEITCHII Baker—DARIEN: rain forest, north slope of Cana-Cuasi Trail, Real District, alt. 1650 m., March 13, 1940, *M. E. & R. A. Terry 1545* (Herb. Field Mus.). Previously known from Costa Rica and Colombia.

CATOPSIS WANGERINI Mez & Wercklé—CHIRIQUÍ: Finca Lérida to Peña Blanca, alt. 1750–2000 m., July 9, 1940, *Woodson & Schery 319.* Previously known from Costa Rica.

GUZMANIA DONNELLSMITHII Mez ex Donn. Smith—COCLÉ: epiphytic, vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., May 12, 1941, *P. H. Allen 2382* (U. S. Nat. Herb.). Previously known from Costa Rica.

GUZMANIA GLOMERATA Mez & Wercklé—COCLÉ: epiphytic, north rim of El Valle de Antón near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 199;* DARIEN: epiphytic, Cana-Cuasi Trail, Chepigana District, alt. 1200 m., March 12, 1940, *M. E. & R. A. Terry 1526* (Herb. Field Mus.); same (Camp 2), alt. 600 m., *M. E. & R. A. Terry 1528* (Herb. Field Mus.). Previously known from Costa Rica; identified by description.

GUZMANIA GUATEMALENSIS L. B. Smith—COCLÉ: epiphytic, vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., May 12, 1941, *P. H. Allen 2368* (U. S. Nat. Herb.); DARIEN: epiphytic, rain forest, Cana-Cuasi Trail near crest, Chepigana District, alt. 1500 m., March 15, 1940, *M. E. & R. A. Terry 1589* (Herb. Field Mus.). Previously known from Guatemala and Colombia.

GUZMANIA MUSAICA (Linden) Mez—DARIEN: epiphytic, rain forest, crest, Cana-Cuasi Trail, Real District, alt. 1650 m., March 16, 1940, *M. E. & R. A. Terry 1608* (Herb. Field Mus.). Previously known from Colombia.

PITCAIRNIA VALERII Standley—PANAMÁ: terrestrial, Cerro Campana, alt. 1000 m., April 21, 1941, *P. H. Allen 2414* (U. S. Nat. Herb.). Previously known from Costa Rica.

THECOPHYLLUM ACUMINATUM L. B. Smith—PANAMÁ: epiphytic, summit of Cerro Campana, alt. 800–1000 m., Sept. 1, 1940, *P. H. Allen 2215* (Herb. Field Mus.). Previously known from Costa Rica.

THECOPHYLLUM CRASSIFLORUM Mez & Wercklé—CHIRIQUÍ: terrestrial, Potrero Muleto to summit, Volcán de Chiriquí, alt. 3500–4000 m., July 13–15, 1940, *Woodson & Schery 453*. Previously known from Costa Rica.

THECOPHYLLUM ORORIENSE (Mez) Mez—CHIRIQUÍ: Finca Lérida to Peña Blanca, alt. 1750–2000 m., July 9, 1940, *Woodson & Schery 321*. Previously known from Costa Rica. Bracts green with orange tips instead of yellow and scarlet, but the plant otherwise close to the type.

TILLANDSIA ACOSTAE Mez & Tonduz—CHIRIQUÍ: epiphytic, vicinity of Puerto Armuelles, alt. 0–75 m., July 28–31, 1940, *Woodson & Schery 823*. Previously known from Costa Rica.

TILLANDSIA COMPLANATA Benth.—CHIRIQUÍ: epiphytic, vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *Woodson & Schery 602*. Previously known from Costa Rica, the West Indies and northwestern South America.

TILLANDSIA INCURVA Griseb.—CHIRIQUÍ: epiphytic, vicinity of Finca Lérida, alt. 1750 m., July 7–11, 1940, *Woodson &*

Schery 223. Previously known from Costa Rica, southern Florida, Cuba, Jamaica, Venezuela, Colombia and Bolivia.

VRIESIA PACHYSPATHA Mez & Wercklé—CHIRIQUÍ: epiphytic, vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 679.* Previously known from Costa Rica; identified from description.

LILIACEAE

ANTHERICUM APODASTANTHUM Donn. Sm.—CHIRIQUÍ: Potrero Muleto, Volcan de Chiriquí, alt. 3500 m., July 13, 1940, *Woodson & Schery 379.* Previously known from Guatemala and Costa Rica.

ANTHERICUM MACROPHYLLUM Baker—COCLÉ: north rim of El Valle de Antón, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson, Allen & Schery 178.* Previously known from Costa Rica. This is probably the same plant recently described as *Anthericum panamense* Standl. (Field Mus. Publ. Bot. Ser. 22: 327. 1940), based on a collection *(Allen 2195)* from the same locality. Our plants agree satisfactorily with Baker's original description.

AMARYLLIDACEAE

ZEPHYRANTHES CITRINA Baker—BOCAS DEL TORO: Isla Colon, alt. 0–120 m., Aug. 25, 1940, *H. von Wedel 543.* Previously known from Tropical America according to Baker, with no locality given. Type supposedly came from British Guiana. The species was described from a living specimen sent to England and cultivated there. It has since been introduced to Florida gardens.

ZEPHYRANTHES ROSEA Lindl.—BOCAS DEL TORO: Isla Colon, alt. 0–120 m., Aug. 25, 1940, *H. von Wedel 544.* Previously known from Cuba and described from a horticultural specimen brought to England. The species has since been introduced to Florida.

ZEPHYRANTHES TUBISPATHA Herb.—BOCAS DEL TORO: Isla Colon, alt. 0–120 m., Aug. 25, 1940, *H. von Wedel 542.* Previously known from Argentina? and Jamaica according to the Bot. Mag. A specimen, supposedly this species, from Tobago

is in the herbarium of the Missouri Botanical Garden. The species has been introduced into Florida where it is cultivated.

DIOSCOREACEAE

(C. V. Morton, Washington, D. C.)

DIOSCOREA STANDLEYI Morton—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 21, 1940, *Woodson & Schery 664, 652.* Previously known from Costa Rica.

MARANTACEAE

CTENANTHE DASYCARPA (Donn. Sm.) K. Sch.—BOCAS DEL TORO: Isla Colon, Aug. 14, 1940, *H. von Wedel 433.* Previously known only from Costa Rica.

ORCHIDACEAE

(Louis O. Williams, Cambridge, Mass.)

PALMORCHIS **trilobulata** L. O. Williams, sp. nov. (pl. 20). Herbae terrestres, caespitosae, usque ad 35 cm. altae. Folia subchartacea, plicata, elliptica, acuta vel acuminata. Inflorescentia terminalis, pauciflora; bracteae ellipticae vel lanceolato-ovatae, acutae vel acuminatae. Sepalum dorsale spathulato-oblanceolatum, obtusum, tri- vel quinquenervium. Sepala lateralia spathulato-oblanceolata, obtusa, arcuata, tri- vel quinquenervia. Petala lineari-oblanceolata, obtusa, leviter arcuata, trinervia. Labellum oblanceolato-flabellatum, trilobulatum; lobi laterales rotundati, obtusi; lobus medius transverse oblongus, lobos laterales paulo excedens. Columna generis.

Caespitose, terrestrial herbs up to 35 cm. tall. Stems up to about 15 cm. long and 4 mm. in diameter, bearing 3–4 leaves near the apex. Leaves subchartaceous, plicate; lamina of the mature leaves 10–22 cm. long and 3–6 cm. broad, elliptic, acute or acuminate, with 7 prominent nerves; petiole up to 7 cm. long, plicate, nervose. Inflorescence up to 7 cm. long, terminal, much exceeded by the leaves, few-flowered; rachis about 3–4 cm. long; bracts 1–1.5 cm. long and 1.5–5 mm. broad, elliptic to lanceolate-ovate, acute or acuminate. Flowers about 13 mm. long, white. Dorsal sepal about 12 mm. long and 3 mm. broad, spatulate-oblanceolate, obtuse, 3–5-nerved. Lateral sepals 10–

12 mm. long and 3–4 mm. broad, arcuate, spatulate-oblanceolate, obtuse, 3–5-nerved, somewhat carinate along the midnerve dorsally. Petals 11–12 mm. long and about 2 mm. broad, linear-oblanceolate, obtuse, somewhat arcuate, 3-nerved. Lip 10–12 mm. long and about 5–6 mm. broad near the apex, oblanceolate-flabellate, trilobulate at the apex, the base or claw adnate to the column along its median line for about 2–3 mm., more or less enfolding the column; disc of the lip pubescent, especially so toward the base and less so toward the apex, fleshy-thickened toward the apex; lateral lobes about 1 mm. long (free portion), rounded, obtuse; mid-lobe about 1.5 mm. long, transversely oblong, blunt, slightly exceeding the lateral lobes. Column slender, arcuate, about 10 mm. long; anther operculate, incumbent; pollinia 4, exappendiculate, ceraceous or appearing so, pyriform.—COCLÉ: terrestrial, flowers pure white; region north of El Valle de Antón, trail to Las Minas, alt. about 1000 m., May 10, 1941, *Allen 2463* (Herb. Ames, TYPE); terrestrial, flowers white; El Valle de Antón and vicinity, alt. 500–700 m., July 23–27, 1935, *Seibert 459* (Herb. Missouri Bot. Gard., Herb. Field Museum, Herb. Ames).

Palmorchis trilobulata is not easily confused with any previously described species of the genus. It is, perhaps, most closely allied to *P. Powellii* (Ames) Schweinf. & Correll, from which it is easily distinguished both vegetatively and by the size of the flowers, and especially by the very different lip.

PELEXIA FUNCKIANA (Rich. & Gal.) Schltr.—COCLÉ: terrestrial, flowers green; vicinity of La Mesa, hills north of El Valle de Antón, alt. about 1000 m., Jan. 21, 1941, *Allen 2315*. Previously known from Mexico, British Honduras, Guatemala and Costa Rica, possibly also in South America.

ACOSTAEA COSTARICENSIS Schltr.—COCLÉ: epiphytic, flowers tan; hills north of El Valle de Antón, alt. about 1000 m., Jan. 21, 1941, *Allen 2352*. The genus is new to Panama, previously known from Costa Rica.

PLEUROTHALLIS CONCAVIFLORA C. Schweinf.—COCLÉ: epiphytic; vicinity of El Valle de Antón, alt. about 600 m., Dec. 10, 1939, *Allen 2058;* epiphytic; vicinity of La Mesa, hills north of

El Valle de Antón, alt. about 1000 m., Jan. 21, 1941, *Allen 2317*. Previously known from Costa Rica.

PLEUROTHALLIS **macrantha** L. O. Williams, sp. nov. (pl. 21, figs. 1–6). Herbae caespitosae, epiphyticae vel terrestres, usque ad 23 cm. altae. Folia elliptica, obtusa, coriacea. Inflorescentia racema pluriflora quam folia duplo longior. Sepalum dorsale ellipticum vel oblanceolato-ellipticum, acutum. Sepala lateralia plusminusve usque ad apices connata, oblongo-oblanceolata, acuta. Petala oblongo-obovata, leviter obliqua, truncata vel paulo retusa. Labellum subteres et supra sulcatum, prope apicem expansum et basi biauriculatum et tricallosum. Columna generis.

Caespitose, epiphytic or terrestrial herbs up to 23 cm. tall. Secondary stems 6–8 cm. long, subequal to the leaves in length on mature plants, almost completely invested with 1 or 2 loose, scarious sheaths, unifoliate. Leaves 4–7 cm. long and 1.5–2.8 cm. broad, elliptic, obtuse, coriaceous. Inflorescence a several-flowered raceme, about twice exceeding the subtending leaves; sheath at the base of the peduncle short, about 9–11 mm. long; bracts 6–7 mm. long, ovate-lanceolate, scarious, semiamplexicaul. Dorsal sepal 16–20 mm. long and 6–8 mm. broad, elliptic to oblanceolate-elliptic, acute, 3-nerved, keeled dorsally along the mid-nerve. Lateral sepals 16–18 mm. long and together 6–8 mm. broad, connate almost to their apices, oblong-oblanceolate, acute, together 4-nerved, somewhat gibbous at the base. Petals about 9–11 mm. long and 5–6 mm. broad near the apex, oblong-obovate, slightly oblique, truncate or slightly retuse, 3-nerved, with an inconspicuous cushion-like callus near the base. Lip 10–12 mm. long and 3–4 mm. broad toward the apex when expanded, about 2 mm. broad near the middle and 3 mm. broad across the auriculate base, subterete and sulcate above, somewhat laterally compressed, expanding toward the apex and into 2 auricles at the base, with 3 small calluses between the basal auricles. Column of the genus.—CHIRIQUÍ: terrestrial, flowers pale greenish-yellow, spotted chocolate; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 666* (Herb. Ames, TYPE).

Pleurothallis macrantha seems to be most closely allied to *P. pachyglossa* Lindl., with which it perhaps shares the distinction of having the largest flowers of the genus. *Pleurothallis macrantha* is distinguished from *P. pachyglossa* by the truncate petals, the laterally compressed lip, which differs in several characters, and by the details of the sepals and clinandrium.

PLEUROTHALLIS MURICATA Schltr. *(P. diuturna* Schltr.)—COCLÉ: epiphytic on Calabash tree; El Valle de Antón, alt. about 800 m., Jan. 20, 1941, *Allen 2294.* New to Panama under this name.

MALAXIS SIMILLIMA (Reichb. f.) O. Kuntze—CHIRIQUÍ: terrestrial; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 685.* New to Panama, previously known from Costa Rica.

EPIDENDRUM (§ EUEPIDENDRUM) **Allenii** L. O. Williams, sp. nov. (pl. 22, figs. 3–5). Herbae epiphyticae, erectae, usque ad 3 dm. altae. Caules ancipiti. Folia elliptica vel lanceolata, acuta vel breviter acuminata. Sepalum dorsale lanceolatum, obtusum. Sepala lateralia sepalo dorsali similia sed leviter arcuata. Petala linearia, uninervia. Labellum unguiculatum; lamina subreniformis, subintegra vel obscure trilobata. Columna sectionis.

Erect epiphytic herbs up to about 3 dm. tall. Stems ancipitous, covered with the bases of the 3 to 6 leaves. Leaves 4–12 cm. long, 1.2–3 cm. broad, elliptic to lanceolate, acute or short-acuminate. Peduncle about 10–15 cm. long, ancipitous, bialate, the wings prominent at the base but disappearing at about the middle of the peduncle. Inflorescence short, the rachis covered with the scarious, imbricated bracts; bracts up to about 1 cm. long. Dorsal sepal about 10 mm. long and 4 mm. broad, lanceolate, obtuse, 5–7-nerved, with a short dorsal apicule near the apex. Lateral sepals similar to the dorsal sepal except somewhat arcuate. Petals about 10 mm. long and 0.75 mm. broad, linear, 1-nerved. Lip unguiculate; the lamina about 10 mm. long and 12 mm. broad, subreniform, subentire or obscurely 3-lobed, the terminal lobe inconspicuous and slightly

retuse, with two approximate submammillar calluses at the base. Column of the section, about 7 mm. long.—COCLÉ: epiphytic, leaves and stem red, sepals and petals pale pink, labellum white; hills north of El Valle de Antón, about 1000 m. alt., July 14, 1940, *Allen 2203* (Herb. Ames, 58635, TYPE).

Epidendrum Allenii seems not to be closely allied to any Central American species of *Epidendrum,* perhaps nearest to *E. panamense* Schltr. and to *E. Lankesteri* Ames (which may be synonyms), but differs from both of these by the very large differently shaped lip, by the wing on the peduncle and by other details.

EPIDENDRUM CRASSILABIUM Poepp. & Endl.—COCLÉ: *Allen 2205; Woodson & Schery 204.* A not uncommon species but apparently new to Panama. Previously known from Costa Rica, the West Indies, Brazil, Dutch Guiana, British Guiana, Venezuela, Colombia, Ecuador and Peru.

EPIDENDRUM DIFFORME Jacq. var. FIRMUM (Reichb. f.) AHS. —CHIRIQUÍ: epiphyte; Finca Lérida to Peña Blanca, alt. 1750–2000 m., July 9, 1940, *Woodson & Schery 298.* This variety has been reported previously from Guatemala and Costa Rica.

EPIDENDRUM (§ EUEPIDENDRUM) **ellipsophyllum** L. O. Williams, sp. now. (pl. 22, figs. 1–2). Herbae epiphyticae usque ad 25 cm. altae. Caules leviter fusiformes et indurati. Folia elliptica, breviter acuminata. Sepala elliptica vel oblanceolata, obtusa. Petala oblanceolata, obtusa. Labellum unguiculatum; unguis columnae adnata; lamina orbiculari-ovata, trilobata, lamellata, lobi laterales parvi. Columna sectionis.

Erect epiphytic herbs up to about 25 cm. tall. Stems slightly fusiform and indurated, with only the annual leaves persisting and the sheaths of the older leaves becoming scarious and disintegrating. Leaves 11–12 cm. long and 2–2.8 cm. broad, elliptic, short-acuminate, usually only 2 or 3 persisting. Peduncles up to about 4 cm. long, ancipitous, generally covered with imbricated bracts. Inflorescence short, 1-, or at most, few-flowered; bracts up to about 2 cm. long, cucullate, lanceolate-triangular, acute. Flowers green, segments stiff and coriaceous. Sepals 10–12 mm. long and 3–4 mm. broad, elliptic to

oblanceolate, obtuse, 5-nerved. Petals about 10–11 mm. long and 3–4 mm. broad, oblanceolate, obtuse, with 3 principal nerves. Lip unguiculate, the claw mostly adnate to the column; lamina 5–6 mm. long and 5–6 mm. broad, orbicular-ovate in outline, 3-lobed, the lateral lobes small and situated toward the base of the lip, with a 2-ridged lamellate callus plate at the junction of the claw and the lamina. Column slender, about 8 mm. long; clinandrium entire and obtuse; pollinia not seen.—COCLÉ: epiphytic, flowers green; hills north of El Valle de Antón, 1000 m. alt., June 23, 1940, *Allen 2178* (Herb. Ames, 58640, TYPE).

Epidendrum ellipsophyllum does not seem to be closely allied to any other Central American species but is perhaps nearest to *E. Lankesteri* Ames.

EPIDENDRUM (§ EUEPIDENDRUM) **gibbosum** L. O. Williams, sp. nov. (pl. 21, figs. 7–10). Herbae epiphyticae vel terrestres usque ad 4 dm. altae. Folia lineari-oblonga vel lineari-lanceolata, obtusa, coriacea. Inflorescentia brevis, racemosa, pauciflora. Sepalum dorsale elliptico-oblongum, obtusum. Sepala lateralia oblongo-ovata, obtusa. Petala elliptica vel oblongo-oblanceolata, obtusa. Labellum late oblongum vel suborbiculare, obtusum et leviter emarginatum, basi cordatum, carnosum, leviter gibbosum. Columna sectionis.

Epiphytic or terrestrial herbs up to 4 dm. tall. Stems simple or branched below, covered with the ample leaf-sheaths. Leaves 9–14 cm. long and 15–18 mm. broad, linear-oblong to linear-lanceolate, obtuse and unequally bilobed, articulate, coriaceous. Leaf-sheaths ample, somewhat inflated, disintegrating with age. Inflorescence short, racemose, few-flowered; bracts 10–18 mm. long and 12–22 mm. broad, cochleate, acute, scarious. Dorsal sepal 10–12 mm. long and 5–6 mm. broad, elliptic-oblong, obtuse, apiculate, 5–7-nerved. Lateral sepals 10–12 mm. long and 6–7 mm. broad, oblong-ovate, obtuse, apiculate dorsally, 7-nerved. Petals about 10 mm. long and 5 mm. broad, elliptic to oblong-oblanceolate, obtuse, 5–7-nerved. Lip about 11–12 mm. long and 9–10 mm. broad, broadly oblong or suborbicular, obtuse or shallowly emarginate, cordate at the

base, fleshy, especially tumid along the median nerve toward the apex, with 2 inconspicuous calluses at the base, basal portion somewhat gibbous and partly enfolding the column. Column of the section, about 4 mm. long.—CHIRIQUÍ: terrestrial, flowers maroon; Casita Alta to Cerro Copete, alt. 2300–3300 m., July 10, 1940, *Woodson & Schery 367* (Herb. Missouri Bot. Gard., TYPE).

Epidendrum gibbosum is most closely allied to *E. barbae* Reichb. f., a species native of Costa Rica, from which it may be distinguished by the shape and base of the lip and the different callus thickenings. The leaves of *E. gibbosum* are quite obtuse and unequally bilobed, while those of *E. barbae* are more or less acute and not unequally bilobed. The column of *E. gibbosum* is situated well down within the gibbous base of the lip while that of *E. barbae* is not. Although the specimen of this species was terrestrial, it is a potential epiphyte.

EPIDENDRUM (§ EUEPIDENDRUM) **pendens** L. O. Williams, sp. nov. (pl. 23). Herbae epiphyticae, pendentes, usque ad 45 cm. longae. Folia elliptica vel elliptico-lanceolata, coriacea, disticha, marginata. Inflorescentia uni–pauciflora. Sepalum dorsale oblongo-oblanceolatum, acutum, carnosum. Sepala lateralia elliptica, acuta, carnosa. Petala linearia, obtusa vel acuta, carnosa. Lamina labelli trilobulata, suborbicularis, nervo medio crassato et nervis radiantibus crassatis ornata; lobi laterales rotundati; lobus medius subquadratus, emarginatus. Columna generis.

Pendent, epiphytic herbs about 45 cm. long. Leaves 9–15 cm. long and 2–3.5 cm. broad, elliptic to elliptic-lanceolate, coriaceous, distichous, marginate, gray, deciduous; leaf-sheaths loose, completely investing the stem, pergameneous, ancipitous, the abscission line prominent. Inflorescence of 1 or few large, terminal flowers subtended by a leaf-like sheath up to 3 cm. long. Flowers large for the genus, green. Dorsal sepal about 5 cm. long and 1.2 cm. broad, oblong-oblanceolate, acute, fleshy, with 5–7 main nerves. Lateral sepals 4.3–4.8 cm. long and 1.5 cm. broad, elliptic, acute, fleshy, with about 7 main nerves. Petals about 4.5–5 cm. long and 2 mm. broad,

linear, somewhat narrowed to the base, obtuse or acute, fleshy, 1-nerved. Lip with the claw adnate with the column to the apex of the column; lamina about 2.5–3 cm. long and 3 cm. broad, 3-lobed, suborbicular in general outline, with a thickened central nerve and with thickened nerves or ridges radiating from it and covering the remainder of the lip, lateral lobes rounded, about 1.5 cm. long, mid-lobe 1–1.5 cm. long and about 1.5 cm. broad, subquadrate, emarginate. Column 1.5–2 cm. long and 6–8 mm. in diameter at the apex, fleshy.—COCLÉ: epiphytic, pendent plants, foliage gray, flower terminal, green; vicinity of La Mesa, El Valle de Antón, alt. about 1000 m., June 22, 1941, *Allen 2570* (Herb. Ames, TYPE).

Epidendrum pendens is most closely allied to *E. Medusae* (Reichb. f.) Pfitz., a rare plant of the Ecuadorian Andes, from which it is easily distinguished by the 3-lobed, nonfimbriated lip. If the genus *Nanodes* Lindl. were maintained this species would be the third one known.

Mr. Allen's note (in lit.) is of considerable interest: "Epiphytic, entire plant directly pendent, foliage distichous, stiff, gray, flowers terminal, green. This is one of the most remarkable orchids I have ever seen. The foliage is a dead, almost lead-gray, although the plant was the picture of perfect health. The flower is the sort of thing that you would expect a child to construct, after being told in a general way what the floral pattern of an orchid should be."

The description is from a dried plant and a single flower preserved in spirits.

EPIDENDRUM RAMOSUM Jacq. var. **angustifolium** (Cogn.) L. O. Williams, comb. nov. *(E. imbricatum* Lindl. var. *angustifolium* Cogn. in Mart. Fl. Bras. 3[5]: 171. 1898, as var. *angustifolia; E. imbricatum* Lindl. Gen. & Sp. Orch. Pl. 110. 1831, non Lam.; *E. ramosum* Jacq. var. *imbricatum* (Lindl.) Ames, Hubbard & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2: 47. 1934). —BOCAS DEL TORO: epiphytic, Río Cricamola, between Finca St. Louis and Konkintoë, alt. 10–15 m., Aug. 12–16, 1938, *Woodson, Allen & Seibert 1898.* Cogniaux' varietal name is correct

for this unit when it is maintained as a variety. The specimen cited above is the only one from Panama.

SCAPHYGLOTTIS **Lindeniana** (Rich. & Gal.) L. O. Williams, comb. nov. (*Hexadesmia fasciculata* Brongn. in Ann. Sci. Nat. Bot. II, **17**: 44. 1842, non *Scaphyglottis fasciculata* Hook.; *H. Lindeniana* Rich. & Gal. in Ann. Sci. Nat. Bot. III, **3**: 23. 1845; *H. rhodoglossa* Reichb. f. in Bonplandia **4**: 326. 1856; *H. pachybulbon* Schltr. in Fedde Repert. Beih. **17**: 26. 1922; *H. falcata* C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. **8**: 45, *pl.* 1940).—COCLÉ: epiphyte, flowers light green; hills north of El Valle de Antón, alt. 800–1000 m., Jan. 2, 1941, *Allen 2291*. An extremely variable species as to flower size, the present specimen having very small flowers. Previously known from Mexico to Panama.

SCAPHYGLOTTIS (§ HEXADESMIA) **tenella** L. O. Williams, sp. nov. (pl. 24). Herbae epiphyticae, tenellae, caespitosae, usque ad 5 dm. altae. Caules elongati, tenelli, sub apicibus fusiformes. Folia linearia vel lineari-lanceolata. Sepala lanceolata, acuta. Petala oblongo-lanceolata, acuta vel obtusa. Labellum rhombico-lanceolatum. Columna sectionis.

Slender, caespitose, epiphytic herbs up to about 5 dm. tall. Stems elongated, slender, becoming naked and in age swollen and fusiform below the summit, bifoliate. Leaves 20–23 cm. long and 7–16 mm. broad, linear to linear-lanceolate, acute or the apex minutely bilobulate. Inflorescence terminal in the axis of leaves, a fascicle of 1 or few flowers. Dorsal sepal 8–9 mm. long and 3–3.5 mm. broad, lanceolate, acute, 5-nerved. Lateral sepals 8–9 mm. long and 3–4 mm. broad, lanceolate, acute, 5–7-nerved. Petals 8–9 mm. long, 3–3.5 mm. broad, oblong-lanceolate, acute or obtuse, 3- or 5-nerved. Lip about 8–9 mm. long and 4–5 mm. broad, rhombic-lanceolate but somewhat constricted above the middle, fleshy. Column of the section, about 5 mm. long; pollinia 6, waxy.—COCLÉ: epiphytic; hills north of El Valle de Antón, alt. 800–1000 m., Nov. 21, 1940, *Allen 2276* (Herb. Ames, TYPE).

Scaphyglottis tenella is allied to *S. pulchella* (Schltr.) L.

Wms.[1] but is easily distinguished by the smaller flowers and differently shaped lip.

ZYGOPETALUM **parviflorum** L. O. Williams, sp. nov. (pl. 25). Herbae robustae, terrestres vel epiphyticae, usque ad 1 m. altae. Folia lineari-elliptica vel elliptica, acuta vel acuminata, plicata. Scapus bracteosus; inflorescentia racemosa, pluri-multi-flora; bracteae lineares vel lineari-lanceolatae, acutae. Sepalum dorsale oblongo-ovatum, acutum, carnosum. Sepala lateralia oblongo-ovata, obtusa, carnosa. Petala oblonga, obtusa, leviter obliqua. Labellum oblongum, panduratum, apice rotundatum, prope basim callo lunato ornatum. Columna generis.

Robust, terrestrial or epiphytic herbs up to 1 m. tall. Stems leafy, short, becoming thickened into pseudobulbs, up to 9 cm. long and 1.5 cm. thick. Leaves 30–70 cm. long and 2.5–7 cm. broad, linear-elliptic to elliptic, acute or acuminate, plicate, attenuated at the base into a petiole. Scape up to 1 m. long, with several bracts; inflorescence racemose, several–many-flowered, bracts 5–14 mm. long, linear to linear-lanceolate, acute. Dorsal sepal about 10 mm. long and 5 mm. broad, oblong-ovate, acute, fleshy. Lateral sepals 10–11 mm. long and 5–6 mm. broad, oblong-ovate, obtuse, 5-(7-)nerved, fleshy. Petals about 7–8 mm. long and 4–4.5 mm. broad, oblong, obtuse, slightly oblique, 5-nerved. Lip 7–8 mm. long and 6.5–7.5 mm. broad, oblong, panduate, about 2 mm. broader above the middle than below the middle, the apex broadly rounded, with a transverse, lunate callus at the base, fleshy. Column of the genus.—CHIRIQUÍ: terrestrial, flowers purple, lip violet, column white; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 605* (Herb. Ames, TYPE); in rain forest, Bajo Chorro, Boquete District, alt. 6000 ft., Feb. 28, 1938, *Davidson 345*.

Zygopetalum parviflorum is not closely allied to any other species of the genus which is known to me. The flowers are much the smallest of the racemose species of the genus. The

[1] SCAPHYGLOTTIS **pulchella** (Schltr.) L. O. Williams, comb nov. (*Ramonia pulchella* Schltr. in Fedde Repert. Beih. 19: 295. 1923).

present species resembles a *Euzygopetalum* in all respects except the small size of the flowers.

MAXILLARIA **Biolleyi** (Schltr.) L. O. Williams, comb. nov. (*Ornithidium Biolleyi* Schltr. in Fedde's Repert. **9**: 29. 1910).—CHIRIQUÍ: epiphyte in rain forest; Bajo Chorro, Boquete District, alt. about 2000 m., Jan. 14, 1938, *Davidson 125*. Known in Costa Rica and Panama.

MAXILLARIA **Bradeorum** (Schltr.) L. O. Williams, comb. nov. (*Camaridium Bradeorum* Schltr. in Fedde's Repert. Beih. **19**: 141. 1923).—CHIRIQUÍ: epiphyte in rain forest; Bajo Chorro, Boquete District, alt. about 2000 m., Jan. 13, 1938, *Davidson 118*. Known in Costa Rica and Panama.

MAXILLARIA **fulgens** (Reichb. f.) L. O. Williams, comb. nov. (*Ornithidium fulgens* Reichb. f. Beitr. Orch. Cent. Am., p. 76. 1866).—COCLÉ: epiphytic; hills north of El Valle de Antón, alt. 800–1000 m., Nov. 21, 1940, *Allen 2256*. Previously recorded from Costa Rica.

MAXILLARIA **umbratilis** L. O. Williams, nom. nov. (*Camaridium nutantiflorum* Schltr. in Beih. Bot. Centralbl. **36**, Abt. 2: 417. 1918, non *Maxillaria nutantiflora* Schltr.).—CHIRIQUÍ: epiphyte in rain forest; Bajo Chorro, Boquete District, alt. about 2000 m., Feb. 18, 1938, *Davidson 308*. Known in Costa Rica and Panama.

ONCIDIUM PANDURIFORME Ames & Schweinf.—CHIRIQUÍ: epiphyte; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 704*. Previously recorded from Costa Rica.

LEOCHILUS GRACILIS Schltr.—COCLÉ: epiphytic, growing on Calabash, sepals and petals yellow, striped reddish-brown, lip yellow with spot of red at base, pseudobulbs and leaves dark bronzy red; El Valle de Antón, alt. about 800 m., Jan. 20, 1941, *Allen 2295*. Previously recorded from Honduras and Costa Rica.

CAMPYLOCENTRUM BRENESII Schltr.—CHIRIQUÍ: epiphyte; vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *Woodson & Schery 579*. New to Panama, previously known from Costa Rica.

PIPERACEAE

(William Trelease, Urbana, Ill.)

PEPEROMIA **Scheryi** Trel., spec. nov. Herba terrestris sat magna glabra; caulibus inferne crassiusculis superne gracilibus; foliis alternatis peltatis rotundato-ovatis breviter acuteque acuminatis basi aliquantulum concavis ca. 13 cm. longis 8.5 cm. latis, petiolis gracilibus 5–7 cm. longis; spicis solitariis terminalibus ca. 100 mm. longis 5 mm. crassis, pedunculo gracili ca. 2 cm. longo ad apicem in ramulo 2-bracteato ca. 3 cm. longo gesto; baccis elongato-ovoideis rostratis, stigmate ad basim in rostro anteriori gesto.—CHIRIQUÍ: Quebrada Velo, vicinity of Finca Lérida, alt. ca. 1800 m., July 8, 1940, *Woodson & Schery 247* (Herb. Univ. Illinois, TYPE).

PIPER **fagopyricarpum** Trel., spec. nov. Frutex parvus glaber; internodiis elongatis gracillimis; foliis lanceolato-ellipticis apice acute caudatis basi acutis ca. 12 cm. longis 4 cm. latis omnino pinnate nervatis, nervis utraque latere ca. 10, post exsiccationem firme chartaceis, petiolis 0.5 cm. longis; spicis ca. 40 mm. longis 5 mm. crassis, pedunculo gracili 10 mm. longo; baccis sulcate ovoideis apiculatis, stigmatibus parvis.—CHIRIQUÍ: vicinity of Puerto Armuelles, alt. 0–75 m., July 28–31, 1940, *Woodson & Schery 852* (Herb. Univ. Illinois, TYPE).

LORANTHACEAE

PSITTACANTHUS **Scheryi** Woodson, spec. nov. *(Eupsittacanthus Ligulati).* Frutex parasiticus omnino glaber; ramis ramulisque crassis teretibus ad nodos haud incrassatis continuis. Folia opposita vel subopposita breviter petiolata inaequilateraliter rhombo-ovata apice late obtusa vel subrotundata basi latissime cuneata petiolo brevissimo incluso 9–11 cm. longa 6.0–9.5 cm. lata valde coriacea olivacea nervo medio immerso nervis lateralibus penninerviis et vix sensis. Inflorescentiae laterales fasciculatae congestae; pedunculis foliorum petiolos subaequantibus; pedicellis ca. 0.5 cm. longis. Flores gemini inferne aurantiaci superne lutei; cupula prorae simili submembranacea margine integro ca. 0.2 cm. longa 0.1 cm. lata; calyculo urceolato ca. 0.25 cm. alto ostio 0.2 cm. diam. obconico

margine integro; perigonio gracili maturitate 3.2 cm. longo prope basim conspicue (ca. 0.2 cm. diam.) dilatato; lobis 6 basi inconspicue incrassato-appendiculatis; antheris basifixis late oblongis 0.2 cm. longis, filamentis invicem inaequilongis 2.0–2.3 cm. longis paulo supra medium perigonii adnatis; stigmate late fusiformi, stylo perigonium subaequante.—CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *Woodson & Schery 581* (Herb. Missouri Bot. Garden, TYPE).

This striking species is closely related to *Ps. dilatatus* A. C. Smith, of Colombia, but has much broader leaves and a smaller calyculus with entire margin. The plant from which the type specimen was obtained was a magnificent epiphytic shrub of many stout branches, several of which were nearly 6 feet in height.

BALANOPHORACEAE

CORYNAEA CRASSA Hook f.—CHIRIQUÍ: thick bamboo thicket, below Potrero Muleto, Volcan de Chiriquí, alt. ca. 3500 m., July 13–15, 1940, *Woodson & Schery 470*. Previously known from Costa Rica and Colombia. Apparently parasitic on the roots of bamboo. The tuberous rhizomes attain a diameter of nearly a foot.

ANNONACEAE

CYMBOPETALUM **lanugipetalum** Schery, spec. nov. Arbor; ramis novellis brunneo-pubescentibus, internodiis ca. 2 cm. longis; foliis elliptico-lanceolatis subsessilibus, petiolis ca. 0.1–0.2 cm. longis, laminis coriaceis utrinque glabris apice angustis cuspidatisque basi fere obtusis inaequilateraliterque subrotundis 15–27 cm. longis 5–7 cm. latis nervis subtus prominentibus secundariis sat distantibus inter se laxe reticulatis prope marginem late arcuatim confluentibus deinde usque marginem reticulatis. Flores solitarii subterminales; pedicello pendulo ca. 20 cm. longo; sepalis minutis ca. 0.3 cm. longis; petalis interioribus carnosis cucullatis minute velutinis sessilibus triangulari-ovatis ca. 3 cm. longis 1.5 cm. latis venis

profunde immersis; petalis exterioribus coriaceis subtriangularibus sparse puberulis 1.8–2.0 cm. longis 1.0–1.6 cm. latis; staminibus multis capitatis ca. 0.5 cm. longis.—COCLÉ: north rim El Valle de Antón near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 191a* (Herb. Missouri Bot. Gard., TYPE).

This species is characterized by its moderately long pendulous pedicels, glabrous leaves, large fleshy velvety-pubescent inner petals, and very small calyx lobes. The leaves are elliptic-lanceolate with very prominent mid-veins and prominent confluent lateral veins which unite near the leaf margin, giving a lobed appearance to the reticulum. The outer petals are not fleshy and are only slightly more than half as large as the inner ones. The flowers are green.

DESMOPSIS **glabrata** Schery, spec. nov. Arbuscula circ. 3 m. alta; ramulis gracilibus novellis lentissimis pubescentibus vel glabratis, cortice rufo-bruneo, internodiis 3–6 cm. longis; foliorum laminis subcoriaceis, utrinque glabratis, ellipticis, basi cuneatis ibique in petiolum decurrentibus, apice gradatim acuminatis, acumine 5–15 mm. longo, 10–20 cm. longis, 3–6.5 cm. latis, costa supra leviter impresso, subtus valde prominente, nervis lateralibus utrinque 6–8 arcuatim adscendentibus, circ. 5 mm. infra marginem conjunctis; petiolis glabratis asperis, supra canaliculatis, circ. 5 mm. longis; inflorescentiis foliis oppositis vel suboppositis, 1-floris (in typo); pedunculis circiter 1 cm. longis, prope apicem bracteam rotundo-cordatam foliaceam gerentibus, circ. 2 cm. longis; florum pedicellis circ. 6–8 cm. longis, gracillimis, leviter pubescentibus, ad medium quorum est bractea squamiformis circ. 1 mm. longa; sepalis 3, ovato-triangularibus, 3 mm. longis latisque, crassis, extus pubescentibus, intus lepidote glabratis; petalis 6, linearibus vel lineari-lanceolatis, 13 mm. longis, basi 3–4 mm. latis, apice inflexis et obtuse acuminatis, crassis, valvatis, extus pubescentibus, intus lepidote glabratis, basi marginibus vulgo revolutis, staminibus subpeltatis, 1–1.2 cm. longis; ovariis pilosissimis, 7-carpellatis; stylis brevibus; stigmatibus subclavato-capitatis, setaceo-pubescentibus, 2 mm. latis; fructibus ignotis.—BOCAS

DEL TORO: vicinity of Bocas del Toro, alt. near sea-level, Aug. 1, 1940, *H. Wedel 279* (Herb. Missouri Bot. Gard., TYPE).

This species is evidently closely related to *D. microcarpa* R. W. Fries, from which it can be distinguished by the gradually acuminate apex of the leaves, the larger foliaceous bracts, the longer pedicels, and the narrow bluntly acuminate petals, densely pubescent without. The leaves are almost perfectly elliptic, entirely glabrous on both surfaces. The short peduncle bears a large foliaceous bract, from which extends the slender pedicel. Midway up the pedicel is found a small squamiferous bract. The flowers are thick and leathery, densely pubescent without and lepidote-glabrous within. The ovary, style and stigma are densely hairy. The torus is cylindric, truncate.

CUNONIACEAE

WEINMANNIA **pseudolaurina** Woodson, spec. nov. Arbor ut dicitur ca. 8 m. alta; ramulis juventate conspicue compressis minute sparseque pilosulis tandem teretibus glabris. Folia simplicia breviter petiolata late elliptica apice obtusa vel late acuta basi obtusa margine levissime crenata petiolo ca. 0.2–0.4 cm. longo incluso 5–10 cm. longa coriacea nitida subtus nervo medio rare inconspicue pilosulo caeterumque glaberrima. Inflorescentiae fasciculatae ca. 8 cm. longae, axibus minute puberulis. Flores in fasciculis inter se 0.2–0.5 cm. distantibus aggregati; pedicellis 0.2–0.3 cm. longis puberulis. Sepala 5 ovato-lanceolata acuminata ca. 0.1 cm. longa apice minute barbata. Petala ignota. Stamina 10; filamentis anguste subuliformibus ca. 0.2 cm. longis glabris. Ovarium ovoideum ca. 0.1 cm. longum pilosum. Folliculi ca. 0.3 cm. longi dense pilosuli; seminibus late oblongoideis rufis ca. 0.1 cm. longis pilosis.—PANAMÁ: Cerro Campana, trail from Campana to Chica, alt. 600–800 m., Aug. 10, 1941, very common along edges of grassland, *P. H. Allen 2656* (Herb. Missouri Bot. Gard., TYPE).

Weinmannia laurina H.B.K., to which our species is closely related, bears glabrous ovaries and follicles, more lax, elongate inflorescences, and more sharply crenate-serrulate leaves.

CONNARACEAE
(J. A. Steyermark, Chicago)

CONNARUS **Allenii** Steyermark, sp. nov. Folia 3–5-foliolata, foliolis oblanceolatis subito breviter acuminatis, basi angustato-cuneatis, chartaceis, utrinque glabris, nervis lateralibus utroque latere 10–15 fere rectis; inflorescentia lateralis subracemosa, rhachidi 1.8–2 cm. longa, floribus breviter pedicellatis; sepala 2.5 mm. longa subobtusa extus in statu fructifero glabra epunctata; petala 4–4.5 mm. longa lanceolata utrinque glabra epunctata; folliculi 2.3–2.5 cm. longi lateraliter compressi oblique mucronati, basi 5 mm. longe stipitati, pericarpio intus tomentoso.

Tree 6 m. tall, bark of branches light gray, glabrous; leaves 3–5-foliolate, rachis 7–12 cm. long, glabrous; leaflets 8–18 cm. long, 2.2–3.5 cm. broad, oblanceolate, abruptly short-acuminate at apex, narrowed-cuneate at base, chartaceous, dull above, glabrous on both sides; petiolule 2–2.5 mm. long; secondary (lateral) nerves 10–15 on each side, divergent, more or less straight; inflorescence lateral, subracemose, rachis smooth, short, 1.8–2 cm. long; flowers short-pedicellate; sepals 2.5 mm. long, 1–1.25 mm. broad, subobtuse, glabrous (in fruit) on outside, not punctate; petals 4–4.5 mm. long, 1 mm. broad, lanceolate, glabrous on both sides, epunctate; follicle 2.3–2.5 cm. long, 1.5 cm. broad, laterally compressed, obliquely mucronate, stipitate at the base, 5 mm. long; pericarp subligneous, dull orange-brown, glabrous outside, finely lineolate, tomentose within; seed 1.3 cm. long, 0.8 cm. thick, laterally compressed, testa black, shining.—DARIEN: tree 6 m. tall, fruit orange; trail between Pinogana and Yavisa, ca. 15 m., March 17, 1937, *Allen 249* (U. S. Nat. Herb., TYPE, fragment of type in Herb. Field Mus.).

Connarus Allenii is distinct in its narrowly oblanceolate 5-foliolate elongated leaflets and short lateral rachises of the inflorescence. It is related to *C. Turzaninowii,* which differs in its smaller oval leaflets, and to *C. punctatus,* which has the fruit subglabrous instead of tomentose within and broader leaflets.

OXALIDACEAE

OXALIS **coccinea** Woodson & Schery, spec. nov. Suffruticosa ca. 4–5 dm. alta. Caulis basi 2–3 mm. crassus, lignosus brunneus, uno vel duobus ramis magnis basi ex quibus rami minores brevissimi pubescentibus cum pilis adscendentibus oriuntur. Folia inaequilateraliter alternata trifoliolata petiolata. Foliolae facie superiore subglabrae (pilosae juventute), facie inferiore plus minusve dense adpresse pilosae et subglaucoideae; foliola media elliptico-lanceolata, ovato-lanceolata vel elliptica, 15–28 mm. longa, 7–13 mm. lata, apice emarginata vel obtusa, margine paulo undulato, petiolulo 4–5 mm. longo; foliolis lateralibus parvis subsessilibus inaequalibus apice emarginatis, 3–6 mm. longis, 2–4 mm. latis, petiolis plus minusve pubescentibus, 10–15 mm. longis, stipulis destitutis. Pedunculi axillares petiolis longiores, 15–20 mm. longi, pubescentes apice subumbellati; pedicellis brevibus 1–2 mm. longis coccineis pilosis. Sepala coccinea, 4 mm. longa, basi 1 mm. lata, exteriora lanceolata pubescentia. Petala aureo-lutea, ca. 8 mm. longa. Filamenta maiora infra medium appendiculata supra appendicem pubescentia. Styli glabri. Capsula ignota.—BOCAS DEL TORO: near Nievecita, alt. 50 m., Aug. 1940, *Woodson & Schery 1029* (Herb. Missouri Bot. Gard., TYPE).

This species is close to *O. Neaei* DC. but has a more tenuous, less robust habit. The buds and calyces are slightly smaller and tinged a deep red. The young stems and leaflets are also tinged deep red, this being apparent even in the dry plant. The older leaflets are glabrous on the upper surface. The fibrous root system is stout.

RUTACEAE

(C. L. Lundell, Ann Arbor, Mich.)

ZANTHOXYLUM **Scheryi** Lundell, sp. nov. Arbor parva, ramulis crassis, angulatis. Folia imparipinnata; foliola 7 vel 9, petiolulis 5–9 mm. longis; lamina subcoriacea, integra, oblongo-elliptica vel elliptica, 3–7.5 cm. longa, 1.9–4 cm. lata, apice obtusa et emarginata, basi acuta. Inflorescentiae parce puberulae, cymoso-paniculatae, axillares, usque ad 15 cm.

longae. Pedicelli 2.5–3 mm. longi. Sepala 5. Petala 5, glabra, lanceolato-oblonga, 3 mm. longa. Filamenta 2–2.5 mm. longa.

A tree, 6 m. high, branchlets stout, angled, very minutely and sparsely puberulent, essentially glabrous. Leaves odd-pinnate, the petiole up to 6 cm. long, the rachis up to 13 cm. long, the petiole and rachis canaliculate. Leaflets 7 or 9; petiolules canaliculate, 5–9 mm. long; leaf blades subcoriaceous, oblong-elliptic or elliptic, 3–7.5 cm. long, 1.9–4 cm. wide, apex abruptly narrowed, obtuse and emarginate, base acute, decurrent, sparsely puberulent above along the impressed costa, glabrous otherwise, margin entire, paler beneath, costa prominent on under surface, primary lateral veins slender and inconspicuous, 12–14 on each side. Inflorescences cymose-paniculate, axillary, solitary, up to 15 cm. long, including peduncle 9 cm. long, minutely and sparsely puberulent; bracts small, deciduous. Pedicels 2.5–3 mm. long, puberulent. Flowers green-yellow, usually 5-parted. Sepals triangular-ovate, about 0.7 mm. long, acute. Petals glabrous, lanceolate-oblong, 3 mm. long, obtuse and usually emarginate. Filaments 2–2.5 mm. long. Rudimentary pistils usually 5.—CHIRIQUÍ: Potrero Muleto to summit, Volcan de Chiriquí, alt. 3500–4000 m., July 13–15, 1940, *Woodson & Schery 451* (Herb. Univ. Michigan, TYPE).

This remarkable species has affinity to *Z. chiriquinum* Standl. The entire elliptic or oblong-elliptic leaflets and the puberulent panicles up to 15 cm. long are characteristics by which *Z. Scheryi* may be readily separated.

POLYGALACEAE

(S. F. Blake, Washington, D. C.)

POLYGALA FENDLERI Chod. var. HETEROTHRIX Blake.—COCLÉ: between Las Margaritas and El Valle, 1938, *Woodson, Allen & Seibert 1261* (U. S. Nat. Herb.); CHIRIQUÍ: common weed at 800 m., vicinity of El Valle de Antón, alt. 600 m., *Allen 1933* (U. S. Nat. Herb.). Previously known only from Colombia.

POLYGALA GALIOIDES Poir.—COCLÉ: on open llanos, Llano Bonito, north of Las Margaritas, alt. 400–500 m., July 26, 1935, *Seibert 523* (U. S. Nat. Herb.); vicinity of El Valle, alt. 100–800 m., Sept. 5, 1938, *Allen 773* (U. S. Nat. Herb.); CHIRIQUÍ: vi-

cinity of El Valle de Antón, alt. 600 m., *Allen 1932* (U. S. Nat. Herb.). Not previously known north of Colombia, although erroneously recorded by Hemsley from Mexico and Guatemala.

CELASTRACEAE

(C. L. Lundell, Ann Arbor, Michigan)

MAYTENUS WOODSONI Lundell, Ann. Missouri Bot. Gard. **26**: 291. *pl. 22.* 1939 *(Salacia blepharodes* Pittier, Contr. U. S. Nat. Herb. **18**: 159. 1916, not *Maytenus blepharodes* Lundell; *Maytenus vulcanicola* Standl., Field Mus. Publ. Bot. **22**: 153. 1940).—CHIRIQUÍ: a tree, 2–4 m. high, around El Potrero Camp, Volcan de Chiriquí, at edge of forest, alt. 2800–3000 m., March 10–13, 1911, *H. Pittier 3086* (U. S. Nat. Herb., No. 677476, TYPE of *Salacia blepharodes);* a tree, 3 m. high, Loma Larga to summit, Volcan de Chiriquí, alt. 2500–3380 m., July 4–6, 1938, *Woodson, Allen & Seibert 1065* (Herb. Univ. Michigan, TYPE of *M. Woodsoni);* a tree, 3 m. high, flowers maroon, same locality and date, *Woodson, Allen & Seibert 1088;* near summit, Volcan de Chiriquí, alt. about 3700 m., Feb. 12, 1940, *M. E. Terry 1309* (Field Mus. Herb., TYPE of *Maytenus vulcanicola);* a tree, 4 m. high, flowers maroon, Potrero Muleto to summit, Volcan de Chiriquí, alt. 3500–4000 m., July 13–15, 1940, *Woodson & Schery 398;* a small tree, 6 m. high; same locality and date, *Woodson & Schery 440.*

The types of *Salacia blepharodes* and *Maytenus vulcanicola* do not differ from the type of *M. Woodsoni.*

VITACEAE

CISSUS BREVIPES Morton & Standl.—COCLÉ: north rim of El Valle de Antón, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 182.* Previously known from the type locality in Costa Rica.

LOASACEAE

KLAPROTHIA MENTZELIOIDES HBK.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 650.* New to Panama, known previously from South America and Costa Rica.

BEGONIACEAE
(L. B. Smith & B. G. Schubert, Cambridge, Mass.)

BEGONIA VESTITA C. DC.—CHIRIQUÍ: epiphytic, vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 621.* Previously known from Costa Rica.

MELASTOMACEAE
(H. A. Gleason, New York)

CENTRONIA PHLOMOIDES Triana—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 21, 1940, *Woodson & Schery 657.* Previously known only from Costa Rica.

CLIDEMIA SETOSA (Triana) Gleason—COCLÉ: north rim of El Valle, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 200.* Previously known from Vera Cruz to Costa Rica.

MICONIA OINOCHROPHYLLA Donn. Sm.—COCLÉ: north rim of El Valle, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 174.* Previously known from Guatemala, British Honduras, Honduras, and Colombia.

MICONIA PITTIERI Cogn.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20, 1940, *Woodson & Schery 630.* Previously known from Costa Rica.

OSSAEA MICRANTHA (Sw.) Macf.—CHIRIQUÍ: Quebrada Velo, alt. ca. 1700 m., July 8, 1940, *Woodson & Schery 267.* Guatemala to Peru and the West Indies, but apparently new to Panama.

There are five species of *Blakea* in Costa Rica and Panama which are apparently closely related to each other while distinctly different from the other species of the genus from the same regions. They belong to the section Pyxidanthus, in which the thick leathery bracts are connate for nearly or quite their whole length into two cups, which are scarcely different in length and from which the calyx barely protrudes; the leaves are coriaceous and the flowers unusually large. Another feature of all five is the character of the pubescence. This may be abundantly developed or confined to the leaf-buds alone; it consists of conic many-celled hairs closely aggregated into a

velvety indument, from which project other similar hairs of much larger size, up to 2 mm. long. The differences between them may be summarized in a brief key:

Petals coarsely tuberculate; anthers short-spurred at the base.
  Sepals tipped with a reflexed foliaceous appendage; leaf-blades about twice as long as wide.....*B. calycosa* Gl.
  Sepals unappendaged; leaf-blades cordate at base, about as wide as long .....*B. tuberculata* Donn. Sm.
Petals not tuberculate; anthers rounded at the base.
  Younger parts, except the leaf-buds, glabrous or nearly so; leaf-blades 5-nerved, with an additional marginal pair.
    Leaf-blades rounded at the base, the secondary veins spreading at right angles; hypanthium and calyx together 15–18 mm. long.....
    .....*B. intercepta* sp. nov.[1]
    Leaf-blades cuneate at the base, the secondary veins spreading at an angle of 70°; hypanthium and calyx together 20–25 mm. long.....*B. Woodsoni* Gl.
  Young stems, petioles, leaf-veins beneath, peduncles, bracts, and sepals densely pubescent; leaves 5-nerved with an additional marginal pair.....
  .....*B. brunnea* sp. nov.

BLAKEA **brunnea** Gleason, sp. nov. Arbor; rami subteretes, petioli, venae subtus, pedunculi, bracteae, et sepala dense brunneo-velutini. Petioli validi 3–6 cm. longi. Laminae subcoriaceae, ellipticae, usque 20 cm. longae 12 cm. latae, apice breviter apiculatae, basi late rotundatae, supra glabrae opacae venis impressis, subtus brunneae, 5-nerviae jugo marginali neglecto, venis dense pubescentibus valde elevatis, venulis tenuiter pubescentibus sub angulo fere recto divergentibus. Pedunculi solitarii crassissimi 15–20 mm. longi. Bracteae toto connatae, involucram subcylindricam 25 mm. longam formantes. Flores 6-meri. Hypanthium glabrum. Calyx breviter 6-lobatus, extra pubescens. Petala staminaque matura non visa. Antherae dolabriformes 7 mm. longae. Stylus 3 cm.

[1] BLAKEA **intercepta** Gleason, sp. nov. Arbor parva; rami vix cogniti ut videtur ancipites fere glabri. Petioli subglabri 3–4 cm. longi. Laminae ellipticae, usque 20 cm. longae 11 cm. latae, obtusae, apiculatae, basi late acutae, 5-nerviae, jugo marginali neglecto, utrinque fere glabrae, venis lateralibus sub angulo fere recto divergentibus. Inflorescentia floresque ignoti. Bracteae connatae hypanthium amplectentes. Hypanthium glabrum circa 10 mm. longum. Calyx glaber circa 6 mm. longus, indistincte lobatus.

Type collected in Costa Rica by Otto Kuntze, June 20, 1874, and labeled in Kuntze's hand "*Blakea multiflora* Don. *Topobea* Triana."

longus glaber attenuatus.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 615* (Herb. New York Bot. Gard., TYPE).

CONOSTEGIA **chiriquensis** Gleason, sp. nov. Arbor glaberrima, ut videtur parva, ramis crassis rotunde 4-angulatis cicatricibus foliorum rotundis notatis. Petioli gracili, usque 3 cm. longi. Laminae subcoriaceae, ellipticae, usque 12 cm. longae 6 cm. latae, abrupte breviterque caudato-acuminatae, remote denticulatae, basi abrupte cuneatae, 3-nerviae vel vix 3-pli-nerviae, jugo marginali neglecto, venis secundariis sub angulo 70° divergentibus supra obsoletis. Panicula circa 1 dm. longa, a basi ramosa, pedicellis 3–5 mm. longis. Alabastra 9–10 mm. longa in specimine typico, in altero usque 14 mm., abrupte acuminata in rostrum crasse subulatum 2 mm. longum. Hypanthium late poculiforme, 4 mm. longum. Petala late rhomboidea, alba, 12 mm. longa, valde asymmetrica, latere uno in lobum triangularem producto, altero rotundato. Antherae oblongae, obtusae, 2-loculares, 2.8 mm. longae; connectivum dorse proper basin tumidum. Ovarium 6-loculare, fere toto inferum, truncato-conicum; stylus crassus, 4.4 mm. longus; stigma hemisphaericum, 1.5 mm. latum.—CHIRIQUÍ: vicinity of Finca Lérida, alt. 1750 m., July 11, 1940, *Woodson & Schery 376* (Herb. New York Bot. Gard., TYPE); vicinity of Callejon Seco, Volcan de Chiriquí, alt. 1700 m., July 17, 1940, *Woodson & Schery 479* (Herb. New York Bot. Gard., COTYPE).

The closest relatives of *C. chiriquensis* are two Costa Rican species, *C. rhodopetala* Donn. Sm., with more sharply angled branches, longer shining leaves with the secondary veins spreading at right angles, and much smaller petals, and *C. Pittierii* Cogn., with smaller, thinner, proportionately wider, distinctly 3-pli-nerved leaves.

MERIANIA (§ DAVYA) **panamensis** Gleason, sp. nov. Arbor glaberrima 20 m. alta, ramis junioribus subteretibus ad nodos paullo incrassatis. Petioli atropurpurei 25–40 mm. longi. Laminae chartaceae, ovato-ellipticae, usque 13 cm. longae 7 cm. latae, in cuspem brevem obtusam rotundatae, integrae,

basi late cuneatae, 5-nerviae, venulis creberrime reticulatis. Panicula magna ramosa multiflora; flores 5-meri breviter (5 mm.) pedicellati ad apicem ramulorum. Hypanthium late poculiforme 6.5 mm. latum. Calyx patulus, 3.5–4 mm. latus, limbo vix 5-lobato. Petala late et inaequilateraliter cuneato-obovata, 3 cm. longa. Stamina episepala: filamenta 17 cm. longa; antherae crasse subulatae, arcuatae, 7 mm. longae; connectivum non appendiculatum, supra basin tumidum. Stamina epipetala: filamenta 12 mm. longa; antherae graciliter subulatae, valde arcuatae, 12–13 mm. longae; connectivum ad basin productum in appendicem dorsalem linearem apice dilatatam 4 mm. longam. Ovarium superum; stylus gracilis, 13 mm. longus; stigma punctiforme.—CHIRIQUÍ: Casita Alta to Cerro Copete, Volcan de Chiriquí, alt. 2300–3300 m., July 10, 1940, *Woodson & Schery 361* (Herb. New York Bot. Gard., TYPE).

ARALIACEAE

(A. C. Smith, Jamaica Plain)

SCHEFFLERA **epiphytica** A. C. Smith, sp. nov. Frutex epiphyticus circiter 2 m. altus ubique inflorescentia excepta glaber, ramulis crassis subteretibus pallidis striatis; foliis simplicibus, petiolis crassis ad 15 mm. longis, inferne late alatis, superne subteretibus et leviter canaliculatis, medium versus ligula coriacea oblongo-lineari ad 20 mm. longa persistente ornatis; laminis chartaceis siccitate viridi-olivaceis ellipticoblongis, 18–23 cm. longis, 9–11 cm. latis, basi leviter cordatis vel rotundatis, apice abrupte acuminatis (acumine ad 8 cm. longo acuto), margine integris et saepe leviter revolutis, costa utrinque prominente, nervis secundariis utrinsecus 12–16 subpatentibus marginem versus anastomosantibus supra paullo subtus valde prominulis, venulis saepe utrinque prominulis; inflorescentia composito-paniculata, rhachi ramulisque gracilibus striatis mox glabris, pedunculo subnullo, rhachi 2–4 cm. longa, ramulis paucis ad 35 cm. longis (stipitibus ad 10 cm. longis inclusis) bracteis chartaceis oblongis acutis 22–30 mm. longis glabris subtentis; pedunculis numerosissimis patentibus gracilibus sub anthesi ad 9 mm. sub fructu ad 15 mm. longis

minute puberulis mox glabris; floribus 5–8 per umbellam, pedicellis gracilibus primo puberulis sub anthesi ad 3 mm. sub fructu ad 6 mm. longis, bracteis basi pedicellorum membranaceis acutis deltoideis circiter 0.7 mm. longis; calyce levi obconico sub anthesi 1–1.5 mm. longo et circiter 2 mm. diametro, limbo minuto membranaceo, lobis nullis vel obscure apiculatis; petalis membranaceis glabris in calyptram mox caducam connatis, calyptra semiglobosa circiter 2 mm. longa et 2.5 mm. diametro, apice obtuse umbonata, conspicue reticulato-nervata; staminibus 5, filamentis gracilibus 0.4–0.7 mm. longis, antheris deltoideo-ovoideis circiter 1.5 mm. longis, basi subcordatis, apice obtusis, stylis 5 in columnam carnosam conicam cohaerentibus, apice minute liberis, loculis et ovulis 5; fructibus subglobosis ad 3.5 mm. diametro conspicue 5-costatis disco et stylorum columna coronatis.—COCLÉ: epiphytic shrub 2 m. tall, flowers white; hills north of El Valle de Antón, vicinity of La Mesa, alt. 1000 m., Jan. 21, 1941, *Allen 2344* (U. S. Nat. Herb., Nos. 1,806,122 and 1,806,123, TYPE); same locality, *Allen 2723* (Arn. Arb.).

This remarkable plant is at once distinguished from other American species of *Schefflera* by its simple leaves; to the best of my knowledge only two Old World species of the genus with simple leaves are known. The plant is certainly a member of the genus *Schefflera (nomen conservandum propositum;* see A. C. Smith, in Trop. Woods **66**: 5. 1941), agreeing in such unmistakable characters as the conspicuous petiolar ligules, the paniculately umbelliferous inflorescences, and the calyptrate petals. Since both simple and compound leaves are found in such genera as *Oreopanax* and *Didymopanax,* the discovery of a simple-leaved American species of *Schefflera* is not entirely surprising.

VACCINIACEAE

(A. C. Smith, Jamaica Plain, Mass.)

Recent collectors in Panama have obtained several plants of the tribe Thibaudieae of unusual interest; in the present paper eight species and one genus are proposed as new, while five others are reported from Panama for the first time. The

collectors whose plants are cited are Paul H. Allen, M. E. Davidson, C. and W. von Hagen, and R. E. Woodson and R. W. Schery. Their plants have been seen in the following herbaria: Arnold Arboretum (A); Missouri Botanical Garden (Mo); New York Botanical Garden (NY); U. S. National Herbarium (US); the parenthetical letters indicate the place of deposit.

MACLEANIA **epiphytica** sp. nov. Frutex epiphyticus 1 m. altus ubique praeter corollae lobas glaber, ramulis cinereis teretibus gracilibus; petiolis rugosis crassis 4–6 mm. longis; laminis coriaceis siccitate olivaceis oblongo-ellipticis, 5–8 cm. longis, 2–3 cm. latis, basi rotundatis vel late obtusis, apice obtusis, margine integris et incrassatis, 5-pli-nerviis, nervis prope basim orientibus supra subplanis vel prominulis subtus leviter elevatis, costa subtus subprominente, rete venularum utrinque inconspicue prominulo; inflorescentiis apicem ramulorum versus axillaribus fasciculatis vel obscure racemosis 2–4-floris, floribus bracteis minutis subtentis; pedicellis crassis 6–11 mm. longis, apicem versus leviter incrassatis, paullo supra medium bracteolis papyraceis ovato-deltoideis acutis circiter 1.5 mm. longis et latis bibracteolatis; calycis tubo obprismatico sub anthesi circiter 3.5 mm. longo obscure 5-angulato, limbo suberecto lobis late deltoideis acutis circiter 1 mm. longis et 2.5 mm. latis inclusis circiter 2 mm. longo, sinibus rotundatis; corolla tenuiter carnosa cylindrica sub anthesi 17–18 mm. longa et basim versus circiter 5 mm. diametro, apicem versus contracta, lobis 5 deltoideis subacutis circiter 1.5 mm. longis intus albo-puberulis; staminibus 10, filamentis membranaceis liberis ligulatis circiter 3 mm. longis, antherarum loculis 4–4.5 mm. longis, tubulo unico rigido circiter 3 mm. longo rima ovali 2–2.5 mm. longa dehiscente; stylo corollam subaequante, stigmate inconspicuo.—COCLÉ: epiphytic shrub 1 m. high; corolla scarlet, tipped with green; hills north of El Valle de Antón, alt. 1000 m., June 23, 1940, *Allen 2171* (A, TYPE).

Macleania epiphytica, related to those species of the genus with a single anther-tubule and glabrous corollas, sharply differs from them in having its filaments separate rather than connate in a tube. In foliage, the new species suggests *M. com-*

pacta A. C. Smith and *M. insignis* Mart. & Gal., but it has larger flowers than the former and smaller flowers than the latter.

PSAMMISIA **panamensis** sp. nov. Frutex epiphyticus ad 50 cm. altus ubique praeter florum filamentas glaber, ramulis crassis fuscis apicem versus conspicue complanatis; petiolis rugosis crassis (circiter 3 mm. diametro) subteretibus 8–10 mm. longis; laminis tenuiter coriaceis siccitate fuscis oblongo-lanceolatis, 26–34 cm. longis, 5.5–7.5 cm. latis, basi subattenuatis, apice gradatim acuminatis, margine integris et anguste revolutis, pinnatinerviis, costa supra elevata subtus prominente, nervis secundariis utrinsecus 8–10 supra prominulis subtus acute elevatis marginem versus conspicue anastomosantibus, inferioribus adscendentibus superioribus patentibus, rete venularum utrinque prominulo; inflorescentiis axillaribus breviter racemosis sub anthesi ut videtur 6–8-floris, pedunculo subnullo, rhachi 6–10 mm. longa angulata, pedicellis crassis 8–12 mm. longis bracteis papyraceis ovatis subacutis circiter 1.5 mm. longis subtentis, basim versus bracteolis ut bracteis similibus bibracteolatis, apicem versus paullo incrassatis; calyce late campanulato sub anthesi 7–8 mm. longo, tubo 4–5 mm. longo et summo 5–7 mm. diametro, limbo tenuiter coriaceo suberecto circiter 3 mm. longo, lobis 5 deltoideis acutis circiter 2 mm. longis et 3 mm. latis; corolla tenuiter carnosa (basim versus tenuiore) truncato-conica sub anthesi 6–7 mm. longa et basi circiter 5 mm. diametro, apicem versus contracta, lobis 5 deltoideis subacutis circiter 1 mm. longis et latis; staminibus 10, filamentis submembranaceis ligulatis 1.5–2 mm. longis, margine puberulente-ciliolatis, apicem versus angustatis, connectivis angustis alternatis obscure bicalcaratis vel interdum ecalcaratis, antheris rigidis 3.5–4 mm. longis, loculis basi conspicue incurvatis, tubulis cylindrico-conicis circiter 1.5 mm. longis rimis elongatis ovalibus dehiscentibus; stylo corollam subaequante, stigmate inconspicuo.—COCLÉ: epiphytic shrub 50 cm. high; hills north of El Valle de Antón, alt. 1000 m., June 23, 1940, *Allen 2152* (A, TYPE).

Psammisia panamensis is the second species of the genus thus far known from North America, but it is not of the rela-

tionship of *P. ramiflora* Kl. of Costa Rica and Panama. The new species appears to be closely related only to the Peruvian *P. globosa* A. C. Smith, the two being essentially identical in foliage. *Psammisia panamensis,* however, in comparison with its ally, has a substantially larger calyx with conspicuous lobes, a larger and conical (rather than subglobose) corolla, and obviously larger stamens with less conspicuous and essentially unspurred connectives.

THIBAUDIA COSTARICENSIS Hoer. Bot. Jahrb. **42**: 311. 1909; A. C. Smith, Contr. U. S. Nat. Herb. **28**: 425. 1932.—CHIRIQUÍ: tree to 10 m. high, common in rain-forest; corollas pink and white; Boquete Region, Cerro Horquete, alt. about 2000 m., *von Hagen 2023* (A, NY); epiphytic shrub in rain-forest; calyx rose; corolla white; Boquete Region, Bajo Chorro, alt. about 1800 m., *Davidson 380* (A).

The species has previously been known only from Costa Rica, elevations up to 1600 m. only having been reported.

ANTHOPTEROPSIS A. C. Smith, gen. nov.

Frutices, foliis breviter petiolatis, laminis subcoriaceis; inflorescentiis terminalibus vel axillaribus breviter racemosis, floribus pedicellatis bracteis subtentis; calyce cum pedicello articulato alis 5 conspicuis e basi ad apicem adscendentibus lobis alternatis praedito, dentibus 5 inconspicuis; corolla carnosa cylindrica 5-lobata; staminibus 10 aequilongis, filamentis membranaceis, antheris basim versus dorsifixis, loculis leviter granulatis basi paullo incurvatis, connectivis angustatis alternatim summo loculorum calcare mediano unicalcaratis, tubulis 2 ad basim distinctis flexibilibus per rimas ovales introrses elongatas dehiscentibus; ovario in calyce immerso disco annulari complanato coronato, loculis 5, placentis magnis, ovulis numerosis, stylo filiformi corollam subaequante, stigmate minute subcapitato.

ANTHOPTEROPSIS **insignis** sp. nov. Frutex ad 4 m. altus ubique praeter inflorescentiae partes et ramulos juveniles inconspicue puberulos glaber, ramis ramulisque teretibus cinereis gracilibus leviter rimosis juventute fuscis angulatis;

petiolis paullo incrassatis supra complanatis 2–3 mm. longis; laminis elliptico-oblongis, (3–)4–6 cm. longis, (1.5–)2–3 cm. latis, basi anguste rotundatis, apice obtusis vel obtuse cuspidatis, margine integris et anguste recurvatis, 5-pli-nerviis, nervis paullo supra basim orientibus adscendentibus utrinque valde prominulis, costa subtus valde elevata, rete venularum utrinque leviter prominulo; inflorescentiis terminalibus vel raro apicem ramulorum versus axillaribus, 5–12-floris, floribus bracteis papyraceis deltoideis circiter 1.5 mm. longis subacutis inconspicue ciliolatis subtentis, rhachi subtereti ad 1 cm. longa; pedicellis subteretibus rugulosis crassis 15–20 mm. longis superne gradatim incrassatis et saepe inconspicue puberulis, medium versus bracteolis ut bracteis sed circiter 1 mm. longis bibracteolatis; calyce carnoso subgloboso sub anthesi alis inclusis 8–10 mm. diametro, tubo limbum longitudine subaequante, limbo erecto, dentibus minute apiculatis, alis carnosis (vel siccitate submembranaceis) 2–3 mm. latis, apicibus alarum dentes 1 mm. excedentibus; corolla sub anthesi 16–19 mm. longa et 4–5 mm. diametro, inconspicue 5-angulata, superne pilis fuscis debilibus circiter 0.3 mm. longis parce pilosa demum glabrescente, lobis deltoideis apiculatis circiter 1 mm. longis et 2–2.5 mm. latis, sinibus acutis; staminibus circiter 9 mm. longis, filamentis distinctis basim corollae saepe cohaerentibus pallidis ligulatis circiter 3 mm. longis et basi 1.3 mm. latis, superne dorso pallide hirsutis, antheris circiter 7 mm. longis, loculis 4–5 mm. longis, connectivis pallidis, calcare circiter 0.5 mm. longo, tubulis quam loculis paullo angustioribus acutis.—COCLÉ: large straggling shrub 4 m. high, the stem 15 cm. in diameter, calyx fleshy, pink, corolla yellow; hills south of El Valle de Antón, alt. about 700 m., May 9, 1941, *Allen 2500* (A, TYPE, Mo).

This specimen, one of many remarkable plants collected in Coclé by Mr. Allen, is not readily placed in any existing genus. At first glance (as indicated by my generic name) it suggests *Anthopterus* Hook., but closer examination indicates that it differs in many essential features. Other genera showing certain points of relationship are *Thibaudia* R. & P., *Macleania*

	Macleania	*Psammisia*	*Anthopterus*	*Thibaudia*	*Anthopteropsis*
Calyx:	Articulate with pedicel; sometimes winged to sinuses (wings in *M. pentaptera* Hoer. exceeding the inconspicuous lobes).	Articulate with pedicel; not winged.	Continuous with pedicel; winged to sinuses, but with obvious lobes exceeding the wings.	Usually articulate with pedicel; rarely narrowly winged to sinuses.	Articulate with pedicel; conspicuously winged to sinuses, the wings produced distally and exceeding the inconspicuous lobes.
Corolla:	Tubular or urceolate.	Tubular or urceolate.	Conspicuously winged.	Tubular.	Tubular.
Anthers:	Locules strongly granular; spurs lacking; tubules rigid.	Locules strongly granular; spurs present (but lateral at apex of connective, not median); tubules rigid.	Locules finely granular; spurs lacking; tubules flexible.	Locules finely granular; spurs lacking (vestigial in *T. cupatensis* Huber); tubules flexible.	Locules finely granular; spurs present on alternate connectives, dorsal, median; tubules flexible.

Hook., and *Psammisia* Kl. The accompanying table summarizes the more important points of difference among these genera, as regards their relationship to *Anthopteropsis*.

From this summary it is perceived that *Anthopteropsis* has some essential characters in common with each of the mentioned genera. Its calyx is faintly suggestive of that of *Macleania pentaptera* Hoer., but staminal characters definitely remove it from that genus. The spurs of the connectives of *Psammisia* are of quite a different type from those of the new genus, and in many other respects *Psammisia* may be excluded as a close relative. The conspicuously winged corollas of *Anthopterus* amply differentiate that genus. The species of *Thibaudia* have no suggestion of accentuated calyx-wings, and the vestigial connective-spurs of *T. cupatensis* Huber are hardly of the same type as the spurs of *Anthopteropsis*. Nevertheless, *Thibaudia* may be the closest ally of the new genus. I have already discussed (in Bull. Torrey Bot. Club **63**: 316. 1936) the several elements which have in the past been referred to *Thibaudia*, and it hardly seems advisable to expand that generic concept further by dubious inclusion of the present plant.

CAVENDISHIA **gaultherioides** sp. nov. Frutex epiphyticus ad 1 m. altus ubique glaber, ramulis gracilibus subteretibus cinereis vel purpurascentibus; foliorum laminis subsessilibus (petiolis crassis ad 3 mm. longis et diametro) chartaceis vel tenuiter coriaceis siccitate fusco-olivaceis bullatis ovatis vel suborbicularibus, 5–12 cm. longis, 4–10 cm. latis, basi rotundatis vel leviter cordatis, apice obtusis vel rotundatis, margine integris et anguste revolutis, pinnatinerviis, costa supra basim versus elevata subtus prominente, nervis secundariis utrinsecus 5–10 inferioribus adscendentibus superioribus brevibus patentibus, omnino supra in sulcis prominulis subtus prominentibus marginem versus nervo marginali conjunctis, rete venularum utrinque leviter prominulo; inflorescentiis axillaribus congestis breviter racemosis basi bracteis deciduis suffultis, rhachi crassa (1.5–2 mm. diametro) sub anthesi ad 2 cm longa 5–12 flora; bracteis floriferis papyraceis concavis ellip-

tico-oblongis vel suborbicularibus 6–10 mm. longis et latis, basi paullo angustatis, apice acutis vel rotundatis, conspicue et copiose flabellato-nerviis (nervis utrinque prominulis), margine saepe minute glanduloso-ciliolatis; pedicellis inconspicuis crassis circiter 1 mm. longis bibracteolatis, bracteolis ut bracteis sed angustioribus vel interdum reductis; calyce campanulato circiter 6 mm. longo, tubo circiter 2 mm. longo et 3–4 mm. diametro, limbo erecto-patente summo 4–5 mm. diametro conspicue nervato, lobis 5 ovato-deltoideis, circiter 1.5 mm. longis et 2–3 mm. latis, apice apiculatis, margine glanduloso-ciliolatis, basi saepe minute imbricatis, sinibus acutis; corolla tenuiter carnosa cylindrica 7–10 mm. longa, 3–4.5 mm. diametro, supra medium interdum inconspicue glandulosa, lobis 5 oblongo-deltoideis acutis; staminibus 10 subaequalibus, filamentis membranaceis ligulatis alternatim 2–2.5 mm. et 3–4 mm. longis, antheris alternatim circiter 6 mm. et 5 mm. longis, tubulis quam loculis circiter duplo longioribus; stylo gracili corollam subaequante, stigmate irregulariter peltato.—COCLÉ: epiphytic shrub 50 cm. high, the bracts pink, the corollas white; hills north of El Valle de Antón, alt. 1000 m., *Allen 2170* (A); epiphytic shrub 1 m. high, the bracts shell-pink, the corollas greenish yellow; vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., April 12, 1941, *Allen 2375* (A, TYPE, Mo).

Cavendishia gaultherioides is a remarkably distinct species, characterized by its subsessile pinnate-nerved leaf-blades and its compact inflorescences with conspicuously nerved and often glandular-ciliolate bracts and bracteoles, subsessile flowers, and narrowly imbricate or at least contiguous calyx-lobes. Its only close relatives are *C. complectens* Hemsl. and *C. compacta* A. C. Smith; the former differs in its cordate-based amplexicaul leaf-blades, longer inflorescences, more numerous flowers, obvious pedicels, and its larger eglandular bracts; the latter differs in its larger pli-nerved caudate-acuminate petiolate leaf-blades, elongate inflorescences, large bracts, obviously pedicellate and larger flowers, etc.

CAVENDISHIA **Allenii** sp. nov. Frutex epiphyticus ad 1 m. altus ubique (corolla non visa forsan excepta) glaber, ramulis

subteretibus fusco-cinereis; foliorum laminis subsessilibus (petiolis incrassatis rugulosis 2–3 mm. longis) coriaceis siccitate fusco-olivaceis ovatis, 6.5–10 cm. longis, 4–7 cm. latis, basi rotundatis vel inconspicue subcordatis, apice obtusis vel subrotundatis, margine integris et valde recurvatis, 5-plinerviis, costa supra paullo elevata vel subplana subtus prominente nervis lateralibus utrinsecus 3–5 inconspicuis superne praedita, nervis secundariis e basi orientibus adscendentibus utrinque elevatis, venulis immersis; inflorescentiis axillaribus racemosis, rhachi angulata crassa (1.5–3 mm. diametro) 2.5–6 cm. longa multiflora, floribus congestis; bracteis floriferis papyraceis concavis ellipticis, 17–20 mm. longis, 10–15 mm. latis, apice acutis, margine integris, conspicue et copiose flabellato-nervatis (nervis utrinque prominulis); floribus subsessilibus, pedicellis inconspicuis ad 1 mm. longis bibracteolatis, bracteolis ut bracteis sed angustioribus et paullo brevioribus; calycis tubo post anthesin subgloboso levi 3–5 mm. diametro, limbo erecto papyraceo tubuloso lobis inclusis 7–8 mm. longo basi 2.5–3 mm. apice circiter 4 mm. diametro conspicue striato-nervato, lobis 5 oblongo-deltoideis 2–2.5 mm. longis et latis, apice apiculatis, margine interdum inconspicue glanduloso-ciliolatis, sinibus acutis; fructibus subglobosis ad 15 mm. diametro calycis limbo conspicuo coronatis, pericarpio tenui ut videtur submembranaceo, seminibus numerosis ovoideis circiter 1 mm. longis conspicue scrobiculatis.—COCLÉ: epiphytic shrub 1 m. high; fruit blue; along trail to Las Minas, north of El Valle de Antón, alt. 1000 m., May 10, 1941, *Allen 2471* (A, TYPE).

Although no corollas are available, the cited collection so obviously represents a new species that I venture to describe it. *Cavendishia Allenii* is at once distinguished by its subsessile leaves with rounded bases and obtuse apices, its subsessile flowers, and its papyraceous and conspicuously nerved bracts, bracteoles, and calyx limb, the latter being tubular and elongated. The mature fruit has a remarkably thin pericarp for the genus. The new species is suggestive of the preceding *(C. gaultherioides)* in its subsessile flowers and conspicuously

nerved bracts and bracteoles, but its calyces and foliage are so different that the close alliance of the two is dubious.

CAVENDISHIA **calycina** sp. nov. Frutex epiphyticus ubique glaber, ramulis gracilibus subteretibus cinereis; petiolis rugosis subteretibus crassis (ad 2 mm. diametro) 4–7 mm. longis; laminis coriaceis elliptico-oblongis, 7–11 cm. longis, 3–5 cm. latis, basi rotundatis vel late obtusis, apice acuminatis (acumine gracili ad 2 cm. longo acuto), margine integris et leviter recurvatis, subtus minute nigro-punctatis, 5- vel 7-pli-nerviis, nervis adscendentibus prope basim orientibus cum costa supra leviter impressis subtus prominentibus, exterioribus debilibus, rete venularum supra prominulo subtus subimmerso; inflorescentiis apicem ramulorum versus axillaribus breviter racemosis ut videtur 8–12-floris, rhachi circiter 3 mm. crassa et 10–12 mm. longa; bracteis floriferis papyraceis vel submembranaceis oblongo-ellipticis, 28–30 mm. longis, 16–18 mm. latis, apice rotundatis, margine integris; pedicellis crassis 4–5 mm. longis basim versus bracteolas 2 circiter 4 mm. longas gerentibus; calyce campanulato 7–8 mm. longo, tubo brevissimo circiter 4 mm. diametro, limbo erecto papyraceo lobis inclusis circiter 6 mm. longo, lobis 5 oblongis, 3–3.5 mm. longis, 2.5–3 mm. latis, apicem versus scariosis, apice calloso-apiculatis, margine leviter undulatis et saepe contiguis, sinibus acutis vel anguste rotundatis; corolla tenuiter carnosa cylindrica, sub anthesi 16–18 mm. longa et 3–4 mm. diametro, lobis parvis deltoideis subacutis; staminibus 10 subaequalibus quam corolla paullo brevioribus, filamentis chartaceis nigrescentibus ligulatis alternatim circiter 3 mm. et 5 mm. longis apicem versus obscure cinereo-pilosis, connectivis angustis nigrescentibus, antheris alternatim circiter 14 mm. et 12 mm. longis, tubulis quam loculis circiter duplo longioribus; stylo gracili corollam subaequante, stigmate peltato.—CHIRIQUÍ: epiphyte, in rain-forest, corolla red, tipped with white; Boquete District, Bajo Chorro, alt. about 1800 m., Jan. 18, 1938, *Davidson 157* (A, TYPE).

Although the cited specimen bears only one disintegrated inflorescence and two flowers, the material is quite adequate to in-

dicate that a very distinct new species is represented. While the calyx-lobes are not exactly "imbricate," as indicated in my key (Contr. U. S. Nat. Herb. **28**: 463. 1932) for *C. compacta* A. C. Smith, this Colombian species nevertheless appears to be the closest ally of the new species. *Cavendishia calycina* differs from *C. compacta* in its smaller leaf-blades with the nerves oriented nearer the base, its more compact inflorescences, thinner and larger bracts, and smaller calyx, especially as regards the lobes, which are erect but not imbricate nor thickened at the margin.

CAVENDISHIA CAPITULATA Donn. Sm. Bot. Gaz. **25**: 147. 1898; A. C. Smith, Contr. U. S. Nat. Herb. **28**: 450. 1932.—CHIRIQUÍ: alt. 1500–1900 m., *Allen 1434* (Mo), *Davidson 92* (A), *120* (A), *Woodson & Schery 574* (NY), *576* (Mo), *632* (NY); COCLÉ: alt. 1000 m., *Allen 2721* (A).

Although known from abundant material collected in Costa Rica, the above-cited specimens are apparently the first of the species from Panama.

CAVENDISHIA LONGIFLORA Donn. Sm. Bot. Gaz. **37**: 420. 1904; A. C. Smith, Contr. U. S. Nat. Herb. **28**: 452. 1932.—COCLÉ: epiphytic shrub, the bracts and flowers bright rose; hills north of El Valle de Antón, alt. 650–1000 m., *Woodson & Schery 193* (NY); epiphytic shrub, the branches 2 m. long; bracts rose-pink, the corollas white; *Allen 2207* (A, Mo).

This species has previously been known only from the type locality near La Palma, San José, Costa Rica. A recently collected specimen from the Province of Chiriquí in Panama, *Seibert 176* (US), also doubtless represents the species, but it is a form with very narrow leaves.

CAVENDISHIA STENOPHYLLA A. C. Smith, Ann. Missouri Bot. Gard. **27**: 327. 1940.—COCLÉ: epiphytic shrub 1 m. high; flowers purple; hills north of El Valle de Antón, alt. 1000 m., *Allen 2162* (A); shrub 1.5 m. high, growing on steep banks along trails; flowers deep purple; vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., *Allen 2373* (A, Mo).

The cited specimens are the second and third collections of

the species and precisely match the type, *Allen 1880*, from the Province of Panama. The following description may now be added to the original:

Rhachis inflorescentiae ad 10 cm. longa, corolla tenuiter carnosa cylindrica sub anthesi 16–19 mm. longa et 4–5 mm. diametro, basi paullo contracta, extus pilis circiter 0.3 mm. longis laxe cinereo-puberula, lobis 5 deltoideis subacutis circiter 1 mm. longis et 2 mm. latis; staminibus subaequalibus, filamentis submembranaceis ligulatis distaliter parce puberulis alternatim circiter 2 mm. et 5 mm. longis, antheris gracilibus alternatim circiter 16 mm. et 13 mm. longis, tubulis quam loculis 1.5–2-plo longioribus; stylo gracili corollam subaequante, stigmate obscuro.

Cavendishia **chiriquiensis** sp. nov. Frutex epiphyticus gracilis, ramulis glabris fuscis subteretibus vel apicem versus saepe leviter complanatis; petiolis gracilibus subteretibus 4–7 mm. longis, juventute cinereo-puberulis mox glabris; laminis glabris chartaceis ovatis, 4.5–6 cm. longis, 1.5–2 cm. latis, basi obtusis, apice longe caudato-acuminatis (acumine gracili 1.5–2 cm. longo acuto), margine integris et saepe leviter recurvatis, 3(obscure 5)-pli-nerviis, costa supra paullo impressa subtus elevata, nervis secundariis prope basim orientibus adscendentibus supra subplanis vel leviter impressis subtus prominulis, rete venularum supra saepe prominulo subtus immerso; inflorescentiis praeter corollas glabris axillaribus vel subterminalibus racemosis 6–8-floris, basi decidue bracteatis, pedunculo brevi, rhachi gracili leviter angulata 1.2–3.5 cm. longa; bracteis floriferis conspicuis papyraceis vel submembranaceis obovato-oblongis, 16–25 mm. longis, 4–10 mm. latis, basi angustatis, apice obtusis, utrinsecus glandulas circiter 10 margine gerentibus; pedicellis rectis 4–6 mm. longis basim versus bibracteolatis (bracteolis papyraceis oblongo-lanceolatis 1.5–2 mm. longis saepe glandulosis) apicem versus glandulas paucas magnas (0.2–0.3 mm. diametro) sessiles gerentibus; calyce 3.5–4 mm. longo, tubo cylindrico 2–3 mm. diametro basi obscure apophysato et velut pedicellis glanduloso, limbo papyraceo suberecto 2–3 mm. longo, lobis 5 deltoideis subacutis 0.7–1 mm.

longis textura omnino glandulosis, sinibus complanatis; corolla (unica immatura visa) cylindrica albo-puberulente; stylo persistente gracili 20–22 mm. longo, stigmate obscure peltato. —CHIRIQUÍ: epiphytic shrub, the bracts rose, the flowers pale lavender-blue; vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 688* (NY, TYPE); Boquete Region, *von Hagen 2033* (A, NY).

Although the cited specimens lack mature corollas, I have no doubt that a new species is represented, as the essential characters of the inflorescence are found in the bracts, pedicels, and calyces. From the persistent styles, one may assume that the corolla is about 2 cm. long.

Cavendishia chiriquiensis is a very distinct species, characterized by its small caudate-acuminate, few-nerved leaf-blades, its glandular-margined bracts, and its glandular calyces and pedicels. Among Central American species, it is suggestive only of *C. Endresii* Hemsl., from which it differs in the above-mentioned characters, its shorter pedicels, more conspicuous bracteoles, and presumably longer corollas. Other relatives are the Colombian *C. rhynchophylla* A. C. Smith and *C. Purdiei* A. C. Smith, but these differ in obvious features of foliage and inflorescence.

CAVENDISHIA MICONIOIDES A. C. Smith, Contr. U. S. Nat. Herb. **28**: 503. 1932. (*Thibaudia melastomoides* H. B. K. Nov. Gen. & Sp. **3**: 272. 1818; *Cavendishia melastomoides* Hoer. Bot. Jahrb. **42**: 279. 1909; non Hemsl. 1881).—CHIRIQUÍ: tree 5 m. high; corolla red, white-tipped; between Casita Alta and Cerro Copete, alt. 2300–3300 m., *Woodson & Schery 357* (NY).

The species has previously been known from numerous collections in Colombia and Ecuador. The cited specimen from Panama has the leaves slightly smaller than the average of those from South America, but I find no consequential separating characters.

CAVENDISHIA PUBESCENS (H. B. K.) Hemsl. Biol. Centr.-Amer. Bot. **2**: 273. 1881; A. C. Smith, Contr. U. S. Nat. Herb. **28**: 485. 1932.—CHIRIQUÍ: shrub 2–3 m. high; bracts pale pink;

corolla white, faintly pink-tinged; Boquete Region, alt. about 1150 m., *Davidson 649* (A).

In making the above-cited combination, Hemsley cited *Seemann 1613* from Boquete, but, since I had not seen any material of the species from Panama in 1932, I did not include Panama in the range of this common South American species.

SATYRIA **Allenii** sp. nov. Frutex epiphyticus multiramosus ubique praeter inflorescentiam glaber, ramis ad 2.5 m. longis, ramulis crassis subteretibus (juventute angulatis) demum cinereis; petiolis rugosis crassis 6–10 mm. longis; laminis coriaceis siccitate fuscis elliptico-oblongis, 6–9 cm. longis, 2–3 cm. latis, basi acutis vel attenuatis, apice cuspidatis (acumine ad 4 mm. longo obtuso), margine integris et saepe conspicue recurvatis, 5-pli-nerviis, nervis interioribus 1–2 cm. supra basim orientibus cum costa supra impressis subtus prominentibus, nervis exterioribus paullo debilioribus, venulis immersis; inflorescentiis e ramulis defoliatis orientibus breviter racemosis ut videtur 2–6-floris, rhachi gracili glabra ad 8 mm. longa, pedicellis gracilibus (apicem versus conspicue gradatim incrassatis) 9–11 mm. longis distaliter albo-puberulis, basi bracteis oblongis circiter 1.5 mm. longis subtentis, prope medium inconspicue bibracteolatis; calyce ubique extus pilis patentibus circiter 0.2 mm. longis persistenter albo-puberulo, tubo circiter 2 mm. longo et 3 mm. diametro, limbo erecto-patente circiter 2 mm. longo tenuiter carnoso, lobis 5 deltoideis acutis circiter 1 mm. longis et 2.5 mm. latis; corolla carnosa urceolata, 10–13 mm. longa, basim versus 4–6 mm. diametro, apicem versus ad 2–3 mm. diametro contracta, distaliter ut calyce albo-puberula, lobis 5 acutis circiter 0.7 mm. longis et 1.3 mm. latis; staminibus 10 alternatim circiter 4 mm. et 4.5 mm. longis, filamentis glabris in tubo membranaceo pallido circiter 2.5 mm. longo connatis, antheris alternatim circiter 2 mm. et 2.3 mm. longis, tubulis latis poris circiter 0.6 mm. longis dehiscentibus; stylo gracili corollam subaequante, stigmate minuto subpeltato.—COCLÉ: much-branched epiphytic shrub, the branches to 2.5 m. long, the flowers arising from old branchlets; pedicel and calyx coral-pink; corolla coral-pink, the distal

portion pure white; vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., April 12, 1941, *Allen 2367* (A, TYPE).

Satyria Allenii is closely related only to *S. meiantha* Donn. Sm. of Guatemala and British Honduras, from which it differs in its smaller leaf-blades with more highly connate secondary nerves and completely immersed veinlets, its persistently puberulent calyx, and its smaller anthers. The common Central American *S. Warszewiczii* Kl. differs from *S. Allenii* in its long pedicels, glabrous flowers, and much longer corollas and anthers. *Satyria ovata* A. C. Smith differs from the new species in its proportionately broader and obtuse leaf-blades, apparent veinlets, elongate corollas, etc.

DISTERIGMA HUMBOLDTII (Kl.) Nied. Bot. Jahrb. **11**: 224. 1889; A. C. Smith, Brittonia **1**: 222. 1933.—CHIRIQUÍ: epiphytic shrubs with pale pink flowers; vicinity of Bajo Chorro, alt. 1900 m., *Woodson & Schery 633* (NY), *684* (NY).

Although not otherwise reported from Panama, the species occurs in some abundance in the adjacent parts of Costa Rica and also in Colombia; it will doubtless be found in other parts of Panama.

THEOPHRASTACEAE

(C. L. Lundell, Ann Arbor, Mich.)

CLAVIJA **Alleni** Lundell, sp. nov. Arbor, ramulis crassis. Folia petiolata, petiolo ad 2 cm. longo, lamina glabra, subcoriacea, anguste cuneato-oblanceolata, 30–43 cm. longa, 6–7.5 cm. lata, apice acuta vel subacuminata, basi anguste cuneata, margine remote serrulata. Inflorescentiae ♂ pendulae, subpauciflorae, ad 36 cm. longae, parce minute puberulae. Pedicelli ad 2 mm. longi. Flores 4-meri. Sepala basi coalita, suborbicularia, 1–1.2 mm. longa, fimbrillata. Corolla ca. 1 cm. diam., 6 mm. longa, aurantiaca, lobis suborbicularibus. Ovarium floris ♂ substipitiforme.

A tree, 10 m. tall, branchlets thick, about 1.2 cm. in diam., with the leaves crowded at the apex, obscurely and minutely furfuraceous. Petioles thick, up to 2 cm. long, the basal half drying blackish. Leaf blades glabrous, subcoriaceous, slightly paler beneath, narrowly cuneate-oblanceolate, 30–43 cm. long,

6–7.5 cm. wide, apex acute or subacuminate, base narrowly cuneate, decurrent, margin remotely serrulate, the teeth not over 1 mm. long, veinlets reticulate on both surfaces. Staminate racemes borne chiefly below the leaves on old wood, slender, pendulous, up to 36 cm. long, sparsely puberulent, with few scattered flowers. Bractlets minute, triangular, about 0.5 mm. long, minutely puberulent. Pedicels reflexed, minutely puberulent, up to 2 mm. long, usually about 1.4 mm. long. Flowers orange-colored, 4-merous. Sepals suborbicular, 1–1.2 mm. long, fimbrillate. Corolla about 1 cm. in diam., 6 mm. long, the basal third connate, the lobes suborbicular. Staminodia alternate with the petals, small. Stamens united into a tube, conglutinate, 8-dentate from above. Abortive ovary substipitiform.—CANAL ZONE: vicinity of Madden Dam, alt. 100 m., Aug. 1, 1941, *P. H. Allen 2671* (Herb. Missouri Bot. Gard., TYPE; Herb. Univ. Michigan, fragment of TYPE).

The narrowly cuneate-oblanceolate serrulate leaf blades, long pendulous puberulent staminate racemes, and short puberulent reflexed pedicels characterize the species. The other members of the genus known from Central America all have entire leaves.

MYRSINACEAE

(C. L. Lundell, Ann Arbor, Mich.)

ARDISIA **coclensis** Lundell, sp. nov. Arbor parva, ramulis crassis, furfuraceis. Folia petiolata, petiolo ad 1.5 cm. longo, lamina subcoriacea, integra, cuneato-oblanceolata vel elliptico-oblonga, 15–22 cm. longa, 5.6–8.2 cm. lata, apice acuta, basi cuneata. Inflorescentiae terminales, pyramidales, corymbosae, lepidotae. Pedicelli ad 1.8 cm. longi. Sepala 5, late ovata, 3–3.5 mm. longa, ciliata, punctata. Petala 5, lanceolato-oblonga, 10–11 mm. longa, acuta, reflexa. Stamina ca. 9 mm. longa.

A small tree, 3 m. high; branchlets thick, furfuraceous, the scales brownish, compact. Petioles stout, up to 1.5 cm. long. Leaves clustered at apex of branchlet, the blades pallid, subcoriaceous, entire, cuneate-oblanceolate or elliptic-oblong, 15–22 cm. long, 5.6–8.2 cm. wide, apex acute, base cuneate, decurrent, sparsely lepidote beneath, costa slightly impressed

above, prominent beneath, the primary lateral veins fine but evident on both surfaces, obscurely reticulate. Inflorescence brown-lepidote, terminal, pyramidal, weak with slender rachis and primary branches, 22 cm. long, 18 cm. wide, the flowers corymbose, comparatively few, large, rose-pink. Pedicels lepidote, slender, up to 1.8 cm. long. Sepals 5, free almost to base, broadly ovate, 3–3.5 mm. long, apex rounded and obliquely emarginate, lepidote and punctate, ciliate. Petals 5, cohering at base only, lanceolate-oblong, 10–11 mm. long, acute, inconspicuously punctate, reflexed at anthesis. Stamens about 9 mm. long; filaments united into a tube about 2 mm. long; anthers sessile, erect, lanceolate, acuminate, cohering at base. Ovary subglobose, glabrous; style equaling stamens.—COCLÉ: vicinity of El Valle de Antón, alt. about 600 m., *P. H. Allen 2056* (Herb. Univ. Michigan, TYPE).

A. coclensis, apparently referable to the subgenus Icacorea, has peculiar stamen characteristics somewhat suggestive of the subgenus Walleniopsis. The filaments coalesce into a tube and the erect sessile anthers adhere at base. The species may have affinity to *A. Pittieri* Mez, a plant known to the writer only from Standley's brief description (Field Mus. Publ. Bot. **18**: 893. 1938).

ARDISIA **geniculata** Lundell, sp. nov. Arbor parva, ramulis furfuraceis. Folia petiolata, petiolo 3–6 mm. longo, lamina membranacea, anguste elliptica vel oblanceolato-elliptica, 5.8–11 cm. longa, 2.5–4.3 cm. lata, apice subabrupte acuminata, acumine obtuso, basi attenuata, parce lepidota. Inflorescentiae geniculatae, terminales, lepidotae, subumbellatae. Pedicelli ad 10 mm. longi. Sepala 5, late ovata, 1 mm. longa, subintegra. Petala 5, lineari-oblonga, 5 mm. longa. Stamina 3.5 mm. longa.

A tree, 4 to 5 m. high; branchlets slender, furfuraceous, ferruginous. Petioles furfuraceous, canaliculate, 3–6 mm. long. Leaf blades membranaceous, paler beneath, narrowly elliptic or oblanceolate-elliptic, 5.8–11 cm. long, 2.5–4.3 cm. wide, apex subabruptly acuminate, the acumen obtusish, base attenuate, decurrent, sparsely lepidote, costa plane above, prominent beneath, primary veins 12–16 on each side, conspicuous beneath.

Inflorescence terminal, abruptly geniculate at base, lepidote, bipinnate, few-flowered, less than 4 cm. long, the flowers subumbellate, white. Pedicels slender, up to 10 mm. long. Sepals 5, broadly ovate, 1 mm. long, prominently punctate, the margin scarious, subentire, apex rounded, obscurely emarginate laterally. Petals 5, linear-oblong, slightly wider above middle, 5 mm. long, united (1 mm.) at base, acutish, orange-punctate. Stamens about 3.5 mm. long; filaments stout, less than 1 mm. long; anthers linear-lanceolate, concolorous, abruptly apiculate, dehiscent apically. Ovary glabrous; style slender, 4 mm. long.—CHIRIQUÍ: vicinity of San Bartolomé, Peninsula de Burica, alt. up to 5 m., July 28–Aug. 1, 1940, *Woodson & Schery 944* (Herb. Univ. Michigan, TYPE).

A. geniculata, referable to the subgenus Icacorea, is noteworthy for its geniculate inflorescence.

ARDISIA **rigidifolia** Lundell, sp. nov. Arbor parva, ramulis crassiusculis. Folia petiolata, petiolo crassiusculo, 3–5 mm. longo, lamina rigide coriacea, pallida, elliptica, 3.5–6.5 cm. longa, 2–3.2 cm. lata, apice obtusa, basi late cuneata. Inflorescentiae terminales, pyramidales, ad 7 cm. longae et latae, furfuraceae, umbellatae. Pedicelli 4–5 mm. longi. Sepala 5, ovata, 1–1.3 mm. longa, minute erosa. Petala 5, oblonga, 5 mm. longa, apice acutiuscula. Stamina ca. 3.5 mm. longa. Stylus 5.2 mm. longus.

A small tree, 2.5 m. high; buds and tips of branchlets dark reddish brown, furfuraceous; branchlets rather thick, gnarled, with very short internodes. Petioles stout, 3–5 mm. long. Leaves clustered at ends of branchlets, the blades rigidly coriaceous, pallid, paler on under surface, minutely punctate, elliptic, 3.5–6.5 cm. long, 2–3.2 cm. wide, apex obtuse or obtusely subacuminate, base broadly cuneate, decurrent, costa plane above, prominent beneath, primary veins slender, prominulous beneath. Inflorescence terminal, tripinnately paniculate, pyramidal, up to 7 cm. long and wide, furfuraceous, many-flowered, the flowers white, umbellate; bractlets up to 1 cm. long, lepidote. Pedicels 4–5 mm. long. Sepals 5, ovate, 1–1.3 mm. long, punctate with few conspicuous orange-red glands, the

margin scarious, minutely erose. Petals 5, oblong, 5 mm. long, apex acutish, asymmetrical, punctate with few inconspicuous glands. Stamens about 3.5 mm. long; filaments about 1 mm. long, thick; anthers lanceolate, concolorous, apically dehiscent, not apiculate. Ovary glabrous; style 5.2 mm. long.—COCLÉ: vicinity of El Valle, alt. 800–1000 m., Dec. 22, 1936, *P. H. Allen 71* (Herb. Univ. Michigan, TYPE).

A. rigidifolia is a none too well marked species related to *A. minor* Standl., and referable to the subgenus Icacorea. From *A. minor* it differs in having gnarled branchlets, small rigidly coriaceous leaves, comparatively large tripinnately paniculate furfuraceous inflorescences, smaller sepals, and a longer style.

ARDISIA **Scheryi** Lundell, sp. nov. Arbor glabra, ramulis crassiusculis. Folia petiolata, petiolo ad 8 mm. longo, lamina glabra, integra, coriacea, lanceolata vel lanceolato-elliptica, 4.5–7.5 cm. longa, 1.6–3.2 cm. lata, apice acuminata, basi acutiuscula. Inflorescentiae terminales, pyramidales, multiflorae, umbellatae. Pedicelli 2–3 mm. longi. Sepala fere 1 mm. longa, subintegra. Corolla glabra, 4 mm. longa. Stamina 3 mm. longa. Antherae latae, oblongo-ellipticae, apice rotundatae et minute emarginatae. Ovarium glabrum.

A tree, 20 m. high; branchlets reddish, rather stout, glabrous. Petioles narrowly winged, up to 8 mm. long. Leaf blades entire, glabrous, coriaceous, drying reddish-brown, paler beneath, lanceolate or lanceolate-elliptic, 4.5–7.5 cm. long, 1.6–3.2 cm. wide, apex attenuate, acuminate, base acutish, decurrent, primary veins conspicuous on both surfaces. Inflorescence terminal, pyramidal, up to 14.5 cm. long, 13.5 cm. wide, glabrous, reddish-brown; the flowers pale pink, numerous, umbellate. Pedicels slender, 2–3 mm. long, glabrous. Flower buds about 3 mm. long. Sepals scarcely 1 mm. long, ovate, subentire, scarious, prominently orange-punctate. Corolla 4 mm. long, the petals short connate at base, lanceolate-oblong, acutish, orange-punctate, glabrous. Stamens 3 mm. long; anthers oblong-elliptic, nearly twice as long as filaments, rounded and shallowly notched at apex. Ovary globose, glabrous.—CHIRI-

QUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 686* (Herb. Univ. Michigan, TYPE).

A. Scheryi, which belongs to the subgenus Icacorea, is allied to *A. multiflora* Griseb. and *A. pallidiflora* Standl. From the two, *A. Scheryi* may be recognized immediately by its short pedicels. The tree is remarkably large for the genus.

ARDISIA SEIBERTII Standl., Ann. Missouri Bot. Gard. **24**: 198. 1937.—COCLÉ: flowers white; El Valle de Antón and vicinity, alt. 500–700 m., July 23–27, 1935, *R. J. Seibert 456* (Herb. Field Mus., TYPE); a small tree, 3 m. high, fleshy calyx pink; vicinity of El Valle, alt. 800–1000 m., Dec. 22, 1936, *P. H. Allen 72;* a small tree, 2 m., flowers pale pink; vicinity of El Valle, alt. 800–1000 m., Sept. 5, 1938, *Allen 786;* a tree, 8 m. high, calyx and pedicels white, corolla pink; between Las Margaritas and El Valle, July 15–Aug. 8, 1938, *R. E. Woodson, Jr., P. H. Allen & R. J. Seibert 1239;* a shrub, 3 m. high, petals white, faint lavender-tinged; same locality and date, *Woodson, Allen & Seibert 1746;* a small tree, 4 m. high, flowers pale lavender; north rim of El Valle, June 4, 1939, *P. H. Allen & A. H. G. Alston 1846;* PANAMÁ: a small tree, 3 m. high, flowers pink; summit of Cerro Campana, alt. 800–1000 m., Sept. 1, 1940, *Allen 2226.*

A. Seibertii is very close to *A. opegrapha* Oerst. of the subgenus Graphardisia. *A. opegrapha* has larger narrower oblanceolate rather than elliptic or oblanceolate-elliptic leaves, somewhat less ample inflorescences, shorter fruiting pedicels, and narrower smaller sepals. These are differences of perhaps minor importance.

For the loan of the type of *A. Seibertii,* an isotype of *A. opegrapha,* and other material of these in the Field Museum Herbarium the writer is indebted to the Director, Mr. C. C. Gregg.

ARDISIA **Woodsoni** Lundell, sp. nov. Arbor parva. Folia petiolata, petiolo crassiusculo, ad 6 mm. longo, lamina coriacea, integra, 5–7.5 cm. longa, 1.7–2.8 cm. lata, apice obtusa, basi late cuneata. Inflorescentiae terminales, ca. 5 cm. longae, glabrae, subcorymbosae. Pedicelli 1–1.3 cm. longi. Sepala 5,

late ovata, ca. 2 mm. longa, subintegra. Bacca globosa, 6 mm. diam.

A tree, 8 m. high, buds and tips of branchlets furfuraceous, glabrous otherwise; branchlets slender, terete and brown. Petioles comparatively stout, marginate to base, up to 6 mm. long. Leaf blades coriaceous, paler beneath, entire, 5–7.5 cm. long, 1.7–2.8 cm. wide, apex narrowed to an obtuse point, base broadly cuneate, decurrent, costa plane above, slightly elevated on lower surface, primary veins slender, evident but not conspicuous. Inflorescence terminal, about 5 cm. long, few-flowered, the flowers subcorymbose. Pedicels slender, 1–1.3 cm. long, slightly curved. Sepals 5, broadly ovate, about 2 mm. long, rounded at apex, punctate with conspicuous orange-red dots, the margin scarious, minutely erose, essentially entire. Berries globose, 6 mm. in diam., black-purple when ripe.—CHIRIQUÍ: vicinity of Finca Lérida, alt. 1750 m., July 7–11, 1940, *Woodson & Schery 230* (Herb. Univ. Michigan, TYPE).

A. Woodsoni belongs to the subgenus Icacorea where its nearest relative appears to be *A. minor* Standl. *A. minor* is described as having stout pedicels 2–5 mm. long, while the pedicels of *A. Woodsoni* are slender and usually exceed 1 cm. in length.

PARATHESIS **Woodsoni** Lundell, sp. nov. Arbor, ramulis furfuraceis. Folia petiolata, petiolo 7–12 mm. longo, lamina chartacea, oblanceolata, 5–9 cm. longa, 1.5–2.6 cm. lata, apice acuminata, acumine obtusiusculo, basi acuta, subintegra, supra glabra, subtus parce lepidota. Inflorescentiae axillares, ad 12 cm. longae, parce lepidotae. Pedicelli 7–11 mm. longi. Sepala 5, anguste triangularia, 1–1.2 mm. longa, punctata. Petala 5, extus puberula, intus tomentosa, punctata, lanceolato-attenuata, 6 mm. longa. Stamina 3–3.5 mm. longa, filamentis glabris, antheris ca. 2.3 mm. longis, haud punctatis. Ovarium ad apicem tomentellum; stylus basi tomentellus. Bacca depresso-globosa.

A tree; branchlets furfuraceous, ferruginous, rather slender, with short internodes and conspicuous leaf scars. Petioles furfuraceous, canaliculate, 7–12 mm. long. Leaf blades thinly

chartaceous, oblanceolate, 5–9 cm. long, 1.5–2.6 cm. wide, apex short-acuminate, the acumen obtusish, base acute, slightly decurrent, margin somewhat repand, essentially entire, rather sparsely lepidote beneath, minutely but conspicuously black-punctate, costa slightly impressed above, prominent beneath, the primary veins slender, 11–14 on each side, prominulous. Inflorescence axillary, up to 12 cm. long, with long slender peduncle, sparsely lepidote, ferruginous. Pedicels slender, 7–11 mm. long. Sepals puberulent, punctate, narrowly triangular, 1–1.2 mm. long. Corolla pink, the petals puberulent outside, tomentose within, conspicuously linear-punctate, lanceolate-attenuate, widest at base, 6 mm. long. Stamens 3–3.5 mm. long; filaments glabrous, subequaling anthers; anthers about 2.3 mm. long, base sagittate, attenuate to an acutish apex, concolorous, not punctate. Apical half of ovary and base of style tomentellous, the style about 5 mm. long, linear-punctate. Berries deep purple, depressed-globose, about 7 mm. in diam.—CHIRIQUÍ: Finca Lérida to Peña Blanca, 1750–2000 m., July 9, 1940, *Woodson & Schery 331* (Herb. Univ. Michigan, TYPE).

P. Woodsoni, closely allied to *P. Seibertii* Lundell, differs in its smaller leaves, considerably longer pedicels, larger flowers, and concolorous anthers. The anthers are not punctate, and this is probably the most distinctive characteristic of the plant.

GENTIANACEAE

(Caroline K. Allen, Jamaica Plain, Mass.)

HALENIA **euryphylla**, n. sp. Herba perennis (?), caule simplici ramoso procumbente, inferiori reliquiis foliorum instructo, ad 50 cm. alto, paullo alato; internodiis inferioribus ad 2 cm., superioribus ad 7 cm. longis; foliis sessilibus, superioribus caulinis basi petiolum 0.5–1.5 cm. longum foliaceum simulantibus, longe attenuatis, lamina elliptica conspicue apiculata, 3-nerviis, nervio medio prominente, ad 7.5 cm. longis et 2.7 cm. latis; inflorescentia terminali raro axillari cymosa aliquid laxa et pauciflora, ad 6.5 cm. longa; calyce ad 1 cm. longo et corollae longitudinem ca. ¾ aequante; lobis 3-nerviis oblanceolatis longe apiculatis minute papillosis; corolla (calcaribus in-

clusis) ad 1.5 cm. longa, ad 1 cm. lata, viridescenti-flava (fide collectoris), tubo totae corollae longitudinem ⅓ vel minus aequante; corollae lobis ellipticis, margine eroso; calcaribus corollae longitudinem fere aequantibus divaricatis leviter pendulis; capsula ovata ad 17 cm. longa, stylo apice longe apiculato; seminibus ellipsoideis 1.25 mm. longis.—CHIRIQUÍ: Casita Alta to Cerro Copete, ca. 2300–3300 m., July 10, 1940, *Woodson & Schery 362* (Gray Herb., TYPE, Herb. Missouri Bot. Gard., ISOTYPE).

The foliose stem and the general habit of this new species recall the widespread North American species *H. deflexa*. Actually *H. euryphylla* can claim close relationship with *H. guatemalensis* Loesener, but differs in its broad leaves, looser inflorescence and its flowers with divaricate, slightly pendulous, scarcely incurved spurs.

(J. A. Steyermark, Chicago)

VOYRIA **Allenii** Steyermark, sp. nov. Caulis crassiusculus 9–13 cm. altus, internodiis superioribus 4–5 mm. longis, inferioribus 13–17 mm. longis; flores vulgo solitarii et ramos terminantes, pedunculis 5–9 mm. longis; calycis tubus campanulatus 4.5–5 mm. longus, lobis 5 late ovatis obtusis minute ciliolatis 1.5–3 mm. longis; corolla laete rosea hypocrateriformis extus ubique minute puberula, 3.5–4 cm. longa, lobis elliptico-ovatis obtusis 1.4–1.5 cm. longis 0.8–0.9 cm. latis; filamenta brevissima, antheris subgloboso-rhomboideis 1.2–1.3 mm. longis; stylus gracilis 2.7 cm. longus.

Stem stout, 9–13 cm. high, 2–2.5 mm. thick, once-branched in the upper half; scales opposite, dull red, those on the upper floriferous stems 4–5 mm. apart, the ones in the lower portion of the stems 13–17 mm. apart, broadly ovate, 4–5 mm. long, 3–4 mm. broad, the sinus subacute, obtuse to rounded, minutely ciliolate, connate in lower half to third, glabrous; usually a solitary bright pink flower terminating each branch of the stem; peduncles 5–9 mm. long, stout; calyx-tube campanulate, 4.5–5 mm. long, 3–6 mm. wide at the throat, lobes 5, minutely ciliolate, broadly ovate, obtuse, 1.5–3 mm. long, 1.5–3 mm. broad

at the base, subequal; corolla bright pink, large and showy, hypocrateriform, broadened at the base around the ovary and slightly constricted in the upper portion below the insertion of the stamens, minutely puberulous over the entire outer surface, 3.5–4 cm. long, broadened to 5–6 mm. around the ovary, slightly narrower in upper half, lobes elliptic-ovate, obtuse, the margins round-curved and narrowed at the base, 1.4–1.5 cm. long, 0.8–0.9 cm. broad, minutely papillate without, minutely ciliolate; filaments inserted in the upper half of the tube 6–7 mm. below the throat, very short, 0.5 mm. long; anthers subglobose-rhomboid, 1.2–1.3 mm. long; style slender, 2.7 cm. long, glabrous; stigma dome-shaped, sinuate-peltate; ovary glabrous, ellipsoid, 8–9 mm. long, in fruit 1.5 cm. long, 5 mm. in diameter.—COCLÉ: hills north of El Valle de Antón, alt. 800 m., Sept. 8, 1940, *Allen 2240* (Herb. Field Mus., TYPE).

The genus *Voyria,* as delimited by Aublet and excluding species of *Leiphaimos* which have sometimes been merged with it, comprises a few rare and local species confined to Colombia and British Guiana. The genus has not hitherto been reported for Central America. *Voyria Allenii* is most closely related to *V. macrantha* Killip[1] described from Colombia, from which it differs in its shorter calyx-tube, shorter corolla-lobes, pink instead of red-purple corolla and corolla-tube puberulent throughout on the outside. From *V. rhodochroa* Sandwith,[2] it differs in the flowers borne solitary and terminal on the one or two branches, not fasciculate-corymbose, and in the larger corolla-lobes. From *V. rosea* Aubl. it differs in its obtuse calyx- and corolla-lobes and solitary terminally borne flowers, while from *V. caerulea* Aubl. it differs in its scales and calyx-lobes rounded and not acute, in its pink instead of blue or violet corollas, and fewer-branched stems.

APOCYNACEAE

STEMMADENIA **Allenii** Woodson, spec. nov. Arbuscula ca. 3 m. alta; ramulis gracilibus dichotome compositis omnino glabris. Folia opposita elliptica apice acute subcaudato-

[1] Journ. Wash. Acad. Sci. 26: 361. 1936. [2] Kew Bull. 1931: 55. 1931.

acuminata basi in petiolo brevissimo ca. 0.5 cm. longo gradatim attenuata petiolo incluso 6–15 cm. longa 2.0–5.5 cm. lata membranacea glabra. Inflorescentia 1–4-flora; pedunculo ca. 1 cm. longo; pedicellis ca. 0.5 cm. longis omnino glabris. Calycis lobi oblongi obtusi 0.6–0.9 cm. longi subfoliacei glabri. Corolla "fere alba, centro dilute flava"; tubo proprio ca. 1.25 cm. longo basi ca. 0.3 cm. diam. apicem versus attenuato ibique et staminigero et sinistrorse contorto; faucibus conicis ca. 2 cm. longis ostio ca. 1 cm. diam.; lobis oblique obovatis ca. 1.5 cm. longis patulis. Folliculi anguste gibbosi angustissime attenuati ca. 3.5 cm. longi medio ca. 0.7 cm. crassi.—COCLÉ: hills north of El Valle de Antón, alt. ca. 1000 m., July 14, 1940, *P. H. Allen 2187* (Herb. Missouri Bot. Gard., TYPE); same locality, alt. 800 m., Sept. 8, 1940, *Allen 2239* (Herb. Missouri Bot. Gard., COTYPE).

At first glance, this species was mistaken for *S. Alfari* (Donn. Sm.) Woodson, which, however, has much smaller calyx lobes, and smaller corollas with narrower throat and shorter lobes. Mr. Allen has taken considerable interest in this species, and finds it to be fairly abundant in the neighborhood of the type locality.

ASCLEPIADACEAE

GONOLOBUS **chiriquensis** Woodson, comb. nov. *(Vincetoxicum chiriquense* Woodson, in Woodson & Seibert, Ann. Missouri Bot. Gard. **24**: 199. 1937).

This combination will be made necessary by the impending conservation of *Vincetoxicum* Moench over *Vincetoxicum* Walt. (see Perry, Rhodora **40**: 281–282. 1938).

GONOLOBUS **fuscoviolaceus** Woodson, spec. nov. Frutex volubilis; ramulis gracilibus glabris, internodiis 7–12 cm. longis. Folia petiolata ovato-oblonga basi late rotundata fere cordata apice subcaudato-acuminata 4.5–11.0 cm. longa 1.5–4.5 cm. lata firme membranacea glabra subtus pallidiora, petiolo 1.5–2.5 cm. longo. Inflorescentia bostrycino-umbellata pluriflora; pedunculo ca. 1 cm. longo glabro; pedicellis ca. 0.5 cm. longis glabris; bracteis vix manifestis. Flores viridi-fusci; calycis

laciniis ovato-oblongis acutis glabris 0.25 cm. longis; corolla rotata ca. 0.9 cm. diam. faucibus minute pilosulis caeterumque glabra, lobis late ovatis obtusis minute emarginatis patulis; gynostegio subsessili ca. 0.15 cm. diam., stigmate depresso, polliniis cochleariformibus caudiculis inclusis ca. 0.05 cm. longis; corona rotata margine leviter crenulata gynostegium vix aequante. Folliculi immaturi fusiformes laeves glabri.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 695* (Herb. Missouri Bot. Gard., TYPE). Most closely related to the preceding, but differing in the conspicuously smaller leaves and flowers. These two species differ from those of typical *Gonolobus* in the fact that the anthers are placed about the margin of the stigma head and not beneath it, together with other rather slight characters which probably should be viewed as subgeneric rather than as generic. Similar characters have not been found to be generic in other Gonolobeae.

CONVOLVULACEAE

IPOMOEA DEMERARIANA Choisy (determination from herbarium comparisons, but type not available). Probably the same as *Ipomoea cardiosepala* Meisn. of Colombia, a later name published in Mart. Fl. Bras. Also specimens of this species can be found in herbaria evidently incorrectly labeled as *Ipomoea phillomega* (Vell.) House.—BOCAS DEL TORO: vicinity of Isla Colon, alt. 0–120 m., Aug. 23, 1940, *H. von Wedel 514*. Previously known from South America and the West Indies.

IPOMOEA **mucronata** Schery, spec. nov. Suffrutex volubilis in fruticibus; caulibus, pedunculis petiolisque summe pubescentibus; laminis foliorum integris, lanceolatis, profunde cordatis, 4–9 cm. longis, prope basim 4–9 cm. latis, utrinque pubescentibus praesertim in venulis, petiolis quam laminis longioribus, 4–14 cm. longis; pedunculis quam petiolis longioribus, 10–25 cm. longis; inflorescentiis subcorymbiformibus, floribus multis vel paucis, terminalibus 3.5–4.5 cm. longis, puniceo-purpureis, pedicellis pubescentibus floribus brevioribus (plerumque ca. 1 cm. longis); sepalis subaequalibus,

pilosis, oblongo-ellipticis, apice subulatis vel mucronatis, coriaceis, 7–11 mm. longis, 2–4 mm. latis; stylis persistentibus; capsulis dehiscentibus, bicubiculis, apice leviter pilosis; seminibus glabris, suborbicularibus, ca. 4 mm. diametro cum locis figitis orbicularibus.—PANAMA: CHIRIQUÍ: near Peña Blanca, alt. 1750–2000 m., July 9, 1940, *Woodson & Schery 283, 323* (Herb. Missouri Bot. Gard., TYPE); COSTA RICA: SAN JOSÉ: vicinity of El General, alt. 850 m., Feb. 1936, *A. F. Skutch 2570.*

This species is close to *I. trichocarpa* Ell. and *I. longipes* Garcke, but differs chiefly in having dense pubescence, lavender or rose flowers and pilose sepals. The outer mucronate sepals are slightly smaller than the inner ones. The 2-celled capsule dehisces longitudinally, usually into three parts. In the specimen examined, only one seed developed in each capsule. The seed has a circular, raised, tire-like area at the point of attachment.

VERBENACEAE

(H. N. Moldenke, New York)

CITHAREXYLUM HIRTELLUM Standl.—CHIRIQUÍ: vicinity of Boquete, alt. 1200–1500 m., July 24–26, 1940, *Woodson & Schery 755.*

LABIATAE

(C. C. Epling, Los Angeles)

SALVIA IRAZUENSIS Fern.—CHIRIQUÍ: Potrero Muleto, Volcan de Chiriquí, alt. 10500 m., July 13, 1940, *Woodson & Schery 386.* Previously considered to be an endemic of Costa Rica.

SOLANACEAE

(C. V. Morton, Washington, D. C.)

SOLANUM SEAFORTHIANUM Andrews.—CHIRIQUÍ: vicinity of Finca Lérida, alt. 1750 m., July 7, 1940, *Woodson & Schery 239.* New to Panama. Probably escaped from cultivation.

SOLANUM QUINQUANGULARE Willd.—CHIRIQUÍ: Finca Lérida to Peña Blanca, alt. 1750–2000 m., July 9, 1940, *Woodson & Schery 290.* Previously known from northern South America.

SOLANUM ROBLENSE Bitt.—CHIRIQUÍ: vicinity of Callejon Seco, Volcan de Chiriquí, alt. 1700 m., July 17, 1940, *Woodson & Schery 487.* Previously known from Costa Rica.

SOLANUM EVOLVULIFOLIUM Greenm.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20, 1940, *Woodson & Schery 649*. Previously known from Costa Rica.

GESNERIACEAE

(C. V. Morton, Washington, D. C.)

DRYMONIA ALLOPLECTOIDES Hanst.—COCLÉ: north rim of El Valle de Antón, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 162*. New to Panama. Previously known from Costa Rica.

ALLOPLECTUS ICHTHYODUMA var. PALLIDUS Morton.—CHIRIQUÍ: Casita Alta to Cerro Copete, Volcan de Chiriquí, alt. 2300–3300 m., July 10, 1940, *Woodson & Schery 359*. Previously known from Costa Rica.

COLUMNEA CONSANGUINEA Hanst.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20, 1940, *Woodson & Schery 651*. Previously known from Costa Rica.

CAMPANEA HUMBOLDTII (Kl.) Oerst.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20, 1940, *Woodson & Schery 656*. Previously known from Costa Rica.

BESLERIA PYCNOSUZYGIA Donn. Sm.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 21, 1940, *Woodson & Schery 683*. Previously known from Costa Rica.

ACHIMENES CANDIDA Lindl.—CHIRIQUÍ: llanos, vicinity of Boquete, alt. 1200–1500 m., July 26, 1940, *Woodson & Schery 764*. Previously known from Guatemala and Costa Rica.

ACANTHACEAE

(E. C. Leonard, Washington)

GLOCKERIA **reflexiflora** Leonard, sp. nov. (fig. 1). Herba epiphytica, caulibus subteretibus glabris vel ad nodos puberulis; lamina foliorum oblonga vel oblongo-lanceolata, acuminata, basi angustata, membranacea, undulata, glabra, in costa et venis parce strigosa; petioli breves; panicula grandis, puberula, ramis tenuibus; bracteae subulatae; pedicelli reflexi; calyx glaber, segmentis anguste triangulatis; corolla glabra, aurantiaca, curvata, bilabiata, labio superiore oblongo apice minute

bidentato et serrato, inferiore trilobo, lobis brevibus, latis; stamina exserta; ovarium glabrum.

An epiphytic herb up to 1 meter high; stems subterete, glabrous or puberulent at the nodes; leaf blades oblong or oblong-lanceolate (one leaf of the uppermost pair excepted, this ovate,

Fig. 1. *Glockeria reflexiflora* Leonard: *a*, pair of leaves subtending the panicle to show asymmetry; *b*, portion of panicle; *c*, calyx; *d*, corolla; *e*, upper lip; *f*, lower lip (*a*, *b*, half natural size; *c*, *d*, *e*, *f*, twice natural size.)

subsessile, cordate at base), up to 13 cm. long and 4.5 cm. wide, acuminate (the tip blunt), narrowed at base, thin, undulate, glabrous, or the costa and lateral veins (6 or 7 pairs) sparingly strigillose; petioles up to 5 mm. long; flowers numerous, reflexed, borne in a puberulent terminal panicle 30 cm. long and about 10 cm. in diameter, the ultimate branches very slender;

bracts subulate, up to 3 mm. long; pedicels slender, 2 to 3 mm. long, reflexed; calyx 4 mm. long, glabrous, the segments narrowly triangular, 3 mm. long and 0.5 mm. wide at base, the tips blunt; corolla about 2 cm. long, orange, glabrous, slightly curved, 1 mm. in diameter at base, enlarged from the tip of the calyx to a tubular throat about 4 mm. in diameter, the upper lip erect, oblong, 5 mm. long, 3 mm. wide, rounded, minutely bidentate and serrate at tip, the lower lip short, truncate, with 3 low broad lobes; stamens exserted, the filaments flat, glabrous; ovary glabrous; capsule not seen.—CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *R. E. Woodson, Jr. & R. W. Schery 547* (U. S. Nat. Herb. No. 1,791,983, TYPE).

This species is easily recognized by its large puberulous panicle of reflexed orange flowers.

DICLIPTERA **gracilis** Leonard, sp. nov. (fig. 2). Herba, caulibus breviter striatis, glabris vel ad nodos tomentulosis; lamina foliorum lanceolato-ovata, acuta vel acuminata, basi rotundata, membranacea, integra, glabra, costa et venis obscure strigosis; petioli graciles; cymae tripartitae; pedunculi axillares graciles; bracteae capituli inaequales, coriaceae, ciliatae, intus puberulae, extus glabrae vel costa parce strigosa, bractea posterior linearis, obtusa, anterior lanceolata, apice rotundata; bracteolae lanceolatae, acutae, ciliatae, minute pubescentes; calycis segmenta anguste triangulata, minute pubescentia, leviter striata; corolla incarnata, pubescens, bilabiata, labio superiore acuminato, inferiore trilobo, lobis rotundatis; ovarium glabrum.

Herbaceous; stems up to 30 cm. high or more, ascending, 2 mm. in diameter or less, faintly striate, glabrous, or puberulous at the nodes; leaf blades lance-ovate, up to 3.5 cm. long and 1.6 cm. wide, acuminate at apex (the tip blunt), rounded at base and slightly decurrent on the petiole, thin, entire, glabrous except the costa and lateral veins (6 pairs), these inconspicuously and minutely strigose, more densely so above than beneath, sparingly ciliate, the cystoliths minute; petioles slender, up to 5 mm. long; cymes of 3 capitula on slender peduncles up to

5 cm. long, glabrous; pedicels 1 to 3 mm. long; bracts subtending the cymes similar to the leaves but smaller, those subtend-

Fig. 2. *Dicliptera gracilis* Leonard: *a*, portion of plant, natural size; *b*, calyx, spread to show segments; *c* and *d*, bracts; *e*, bractlet (*b*, *c*, *d*, *e*, twice natural size).

ing the capitula unequal, firm, ciliate, the inner surface appressed-puberulent, the outer surface glabrous or the costa sparingly strigose, the larger bract linear, 13 mm. long, 2.5

mm. wide near tip and base, 2 mm. wide at middle, obtuse, 3-nerved, the lateral nerves inconspicuous, the margins subhyaline near the base, the smaller bract of the pair lanceolate, 7 mm. long, 2.5 mm. wide at base, rounded at apex, 1-nerved, the margins subhyaline; bractlets lanceolate, 5.5 mm. long, 1.5 mm. wide at middle, acute, 1-nerved, finely pubescent toward the tip, ciliate; calyx 7 mm. long, finely pubescent toward tip, ciliate, the hairs of the inner surface appressed, the segments narrowly triangular, 4 mm. long, 1 mm. wide at base, gradually narrowed to a slender tip, faintly striate-nerved; corolla 3 cm. long, bright pink, pubescent (except the lower portion), 2.5 mm. in diameter at base, narrowed to 1.5 mm. at tip of calyx, thence enlarged to about 7 mm. and narrowed again to 4 mm. at mouth, the posterior lip 8 mm. long, acuminate, the lower lip about 5 mm. long, with 3 rounded lobes; ovary glabrous; capsule not seen.—CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July 18, 1940, *R. E. Woodson, Jr. & R. W. Schery 569* (Herb. Missouri Bot. Gard., TYPE).

Related to *D. trifurca* Oerst., but easily distinguished from that by its small thin leaf blades with rounded bases and by the much smaller bracts.

CUCURBITACEAE

FRANTZIA PITTIERI (Cogn.) Pittier—BOCAS DEL TORO: Nievecita, alt. 100 m., Aug. 3–20, 1940, *Woodson & Schery 1062*. Previously known from Costa Rica.

FEVILLEA CORDIFOLIA L.—CHIRIQUÍ: vicinity of San Bartolomé, Peninsula de Burica, alt. 0–50 m., July 28–Aug. 1, 1940, *Woodson & Schery 872*. Previously reported from Costa Rica and evidently widely distributed in tropical America. Also known from the West Indies and South America.

RUBIACEAE

(P. C. Standley, Chicago)

CEPHAELIS **chiriquensis** Standl., sp. nov. Frutex metralis omnino glaber, ramis crassiusculis teretibus, internodiis superioribus 3–7.5 cm. longis; stipulae ca. 1 cm. longae vel paullo breviores crassae fere ad basin bilobae, lobis approximatis late

oblongis apice anguste rotundatis erectis; folia longiuscule petiolata chartacea, petiolo gracili 2.5–3 cm. longo; lamina elliptico-ovalis 9–14.5 cm. longa 4.5–7 cm. lata, apice abrupte breviter acuminata, acumine anguste triangulari, basi acuta, concolor, costa gracili subtus bene elevata, nervis lateralibus utroque latere ca. 20 teneris prominentibus arcuatis regularibus et parallelis, venulis fere obsoletis; inflorescentia terminalis sessilis e capitulis 3 breviter pedunculatis composita, pedunculis crassissimis 7–10 mm. longis; capitula inaequalia, lateralibus paullo minoribus, centrali fere 2 cm. alta et aequilata; bracteae exteriores coriaceae fere 2 cm. longae late ovatae acutae vel acuminatae, interioribus paullo brevioribus ovatis vel oblongo-ovatis, intimis lanceolatis vel lineari-lanceolatis; flores bene evoluti non visi.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 610* (Herb. Field Mus., TYPE).

The bracts are said to be purple. The species is not especially close to any other known from Panama or elsewhere in Central America. The inflorescence is distinctive, consisting of three large, terminal, short-pedunculate heads.

FARAMEA **Woodsonii** Standl., sp. nov. Frutex 1–2-metralis omnino glaber, ramis gracillimis teretibus viridibus, internodiis plerumque brevibus; stipulae 6–7 mm. longae virides breviter connatae sublaxae et non adpressae, basi late ovatae, sensim in setam rigidam attenuatae, persistentes; folia inter minora breviter petiolata laete viridia firme crasseque membranacea, petiolo crassiusculo 3–4 mm. tantum longo; lamina ovali-elliptica vel elliptico-oblonga 5–7.5 cm. longa 1.5–3 cm. lata subito breviter acuminata, basi acuta vel subacuta, supra sublucida, costa tenera prominente, subtus paullo pallidior, costa prominente, nervis lateralibus utroque latere ca. 8 tenerrimis vix elevatis angulo lato fere recto abeuntibus remote a margine laxe junctis, venulis fere obsoletis; inflorescentia terminalis umbelliformis pauciflora erecta 1.5–2 cm. longe pedunculata, basi foliis 2 lanceolato-oblongis viridibus acuminatis 1.5–2.5 cm. longis bracteiformibus fulcrata; pedicelli graciles sed rigidi usque 8 mm. longi inaequales; hypanthium

1.2 mm. altum late obovoideum in sicco cyaneum, calyce vix 0.6 mm. longo remote denticulato, disco crasso calyce fere duplo longiore; corolla caerulea, tubo ca. 8 mm. longo sursum paullo dilatato et vix ultra 2 mm. lato, lobis 4 ut videtur patentibus lineari-lanceolatis longe sensim attenuatis ca. 14 mm. longis; antherae inclusae; stylus gracilis 3 mm. longus.—COCLÉ: north rim of El Valle de Antón, near Cerro Turega, alt. 650–700 m., June 30, 1940, *Woodson & Schery 164* (Herb. Field Mus., TYPE).

Not easily confused with any other Central American species, being well marked by the small umbels of blue flowers, each umbel subtended by two green, bract-like leaves. The general appearance of the plant somewhat suggests that of some species of *Cestrum,* a resemblance observable also in other species of *Faramea,* particularly certain South American ones.

HOFFMANIA AREOLATA Standl.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July, 1940, *Woodson & Schery 661.* A small shrub with yellow flowers. Known previously only from the type, which was obtained in the same region.

HOFFMANIA DAVIDSONIAE Standl.—Known previously only from the type, *Davidson 216,* from Bajo Chorro, Boquete District, Provincia de Chiriquí, at 1800 meters. An additional collection has been made recently: CHIRIQUÍ: vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., July, 1940, *Woodson & Schery 595.* The flowers are described as brownish-yellow; Mrs. Davidson described them as pale pink. Well-developed corollas, not described when the species was published, are present with the later collection. The corolla is glabrous outside, 5 to 6 mm. long, with a very short tube, scarcely one-third as long as the lobes.

HOFFMANNIA **Woodsonii** Standl., sp. nov. Frutex vel arbuscula 2–4-metralis omnino glabra ramosa, ramis subteretibus sordide in sicco brunneis gracilibus, internodiis brevibus; stipulae parvae latissime triangulares acutiusculae; folia inter minora opposita graciliter petiolata membranacea, petiolo 1–2.2 cm. longo; lamina lanceolata usque oblongo-lanceolata, anguste elliptico-lanceolata, vel interdum lanceolato-ovata,

vulgo prope medium latissima, concolor, longe angusteque acuminata, basi cuneato-attenuata et decurrens, costa tenui vix subtus elevata, nervis lateralibus utroque latere 6–7 tenerrimis leviter arcuatis angulo semirecto adscendentibus; flores axillares brevissime racemosi, racemis paucifloris petiolo vulgo paullo brevioribus brevissime pedunculatis, pedicellis gracilibus vix ad 3 mm. longis; hypanthium turbinatum in sicco angulatum 2 mm. longum basi angustatum, lobis 4, ca. 0.6 mm. longis latissime ovato-triangularibus acutiusculis; corolla lutea in alabastro acutiuscula 4–5 mm. longa, tubo crasso, lobis subpatentibus oblongis acutiusculis tubo bene longioribus; antherae lobis corollae paullo breviores; bacca ut videtur fere matura late oblongo-obovoidea vix ultra 2.5 mm. longa.—CHIRIQUÍ: vicinity of Callejón Seco, Volcán de Chiriquí, alt. 1700 m., July 17, 1940, *Woodson & Schery 503* (Herb. Field Mus., TYPE); Quebrada Velo, alt. 1800 m., July 8, 1940, *Woodson & Schery 260.*

In the key to species of *Hoffmannia* in 'North American Flora,' the present plant would run either to *H. chiapensis* Standl., a species of Guatemala and southern Mexico, with which it has no close relationship, or to *H. Pittieri* Standl., of the Volcán de Chiriquí, Panama. It is related to the latter, which, however, is larger in all parts and has a much more ample inflorescence, often copiously branched and always with more numerous flowers.

COMPOSITAE

(S. F. Blake, Washington, D. C.)

ARCHIBACCHARIS **panamensis** Blake, sp. nov. Herba prope apicem ramosa 1.5 m. alta; caulis dense et sordide pilosiusculus; folia oblongo-elliptica v. elliptico-obovata brevissime petiolata acuta basi cuneata tenuia remote calloso-denticulata penninervia supra puberula subtus densius pilosiuscula; capitula feminea numerosa laxe cymoso-paniculata 5 mm. alta 20–21-flora, floribus hermaph. 1–2; phyllaria anguste linearia acuminata dorso puberula; corollae fem. ligulatae, ligula erecta 1 mm. alta ramis styli breviore; corollae hermaph. usque ad apicem tubae 5-partitae.

"Tall herb, 1.5 m. high;" stem simple below the inflorescence, bearing branches in the upper axils, subterete, somewhat striate, pithy, 3 mm. thick, straight, densely pilosiusculous with more or less crisped, many-celled, brownish hairs about 0.2 mm. long, not glandular; petioles broad, naked, sordid-puberulous, 1–1.5 mm. long; blades 7–9 cm. long, 2.3–3 cm. wide, callous-apiculate (apiculus 1 mm. long), remotely denticulate above the entire lower ⅔ of their length (teeth 5–8 pairs, slender, callous-tipped, about 0.5 mm. high, 4–11 mm. apart), above dark dull green, evenly puberulous on surface and veins with several-celled spreading hairs, more densely so on costa, beneath somewhat grayish-green, rather densely spreading-short-pilose with lax several-celled hairs (0.2–0.4 mm. long), more densely so along costa and veins, feather-veined (the principal veins about 6 pairs, prominulous beneath, the veinlets translucent, not prominulous, the costa prominent and whitish at base); leaves of the branches smaller; individual panicles terminal and in the upper axils, loose, many-headed, pubescent like the stem, on peduncles 6 cm. long or less, 1.5–6 cm. wide, together forming a large leafy panicle, the pedicels mostly 6–10 mm. long, filiform, naked or with a filiform-subulate bract; involucre about 4-seriate, graduated, 4–5 mm. high, the phyllaries narrowly linear or the outer linear-subulate, 0.2–0.5 mm. wide, acuminate, with greenish midline and whitish subscarious margin, the outer puberulous throughout, the middle puberulous on back above, the inmost glabrous except for the ciliolate tip; pistillate heads 5 mm. high, thick-cylindric (when moistened), 20–21-flowered, the pistillate flowers 18–20, the hermaphrodite 1–2; pistillate corollas about 2.7 mm. long, the tube slender, densely puberulous at apex, otherwise essentially glabrous, about 1.7 mm. long, the ligule erect, elliptic or oblong, concave, emarginate or 3-denticulate, 0.8–1 mm. long, white; hermaphrodite (staminate) corollas 3.2 mm. long, whitish, the tube 1.5 mm. long, sparsely puberulous, the limb 1.7 mm. long, campanulate, divided to the very base into 5 teeth, these oblong, acute, obscurely puberulous dorsally, about 0.4 mm. wide; achenes (scarcely mature)

of pistillate flowers oblong, strongly compressed, 4-nerved, rather densely hirsutulous, 1.4 mm. long, those of the hermaphrodite flowers inane, linear-oblong, densely hirsutulous, 1.2 mm. long; pappus of slender whitish bristles, about 3 mm. long; style branches of hermaphrodite flowers lance-oblong, very acute, hispidulous, about 0.7 mm. long; staminate plant unknown.—COCLÉ: vicinity of El Valle, alt. 100–800 m., Sept. 5, 1938, *P. H. Allen 751* (U. S. Nat. Herb., No. 1,793,562, TYPE).

Nearest *Archibaccharis irazuensis* Blake, in which the leaves are lanceolate and acuminate, the phyllaries broader, firmer, and less pubescent, the stem-pubescence longer, and the floral details different. In *A. irazuensis* the heads are 31–39-flowered, with 3–6 hermaphrodite flowers; the pistillate corollas are tubular-filiform, without ligule; and the hermaphrodite corollas have a definite throat (about 0.7 mm.), half as long as the teeth or more. *A. panamensis* appears to inhabit a very different life zone, since the recorded altitudes for specimens of *A. irazuensis* examined run from 1500–1900 to 2700–3000 meters in Costa Rica, and 3500–4000 meters in Panama (see below).

The genus *Archibaccharis* has not hitherto been known south of Costa Rica. Two additional species can also be recorded from Panama:

ARCHIBACCHARIS IRAZUENSIS Blake.—CHIRIQUÍ: Volcán de Chiriquí, between Potrero Muleto and summit, alt. 3500–4000 m., July 13–15, 1940, *Woodson & Schery 463*. Previously known from Volcan Irazú and its vicinity, and from the Cerro de las Vueltas in the Province of San José, Costa Rica.

ARCHIBACCHARIS TORQUIS Blake.—CHIRIQUÍ: vicinity of Callejón Seco, Volcán de Chiriquí, alt. 1700 m., July 17, 1940, *Woodson & Schery 481*. Previously known from Vera Cruz to Costa Rica.

PTEROCAULON ALOPECUROIDES (Lam.) DC.—PANAMÁ: hills above Campana, alt. 600–800 m., Dec. 23, 1938, *Allen 1325* (U. S. Nat. Herb.). Previously known from the West Indies and northern South America. The genus, apparently, has not been

recorded heretofore from the Mexican-Central American region.

CLIBADIUM **sessile** Blake, sp. nov. Frutex; caulis (supra) 6-angulatus striatus parce strigillosus; folia elliptico-lanceolata acuminata basi longe cuneata sessilia crenato-serrata pergamentacea longe supra basin triplinervia supra sparse tuberculato-strigillosa non aspera aetate bullata subtus aequabiliter strigillosa ca. 14 cm. longa 4 cm. lata; panicula parva 4 cm. lata terminalis adscendenti-pilosa; capitula parviuscula 4–5 mm. alta sessilia per 3–6 glomerata, glomerulis 5–7 mm. diam. ca. 12 in pedunculis partialibus 4–6 mm. longis; phyllaria 2 ovata obtusa appressa 5–9-nervia breviter ciliata et prope apicem strigillosa; flor. fem. 3, hermaph. 6; receptaculum intra flor. fem. solum 1-paleatum; ovarium fem. glaberrimum.

Shrub 2 m. high; stem sparsely strigillose with subtuberculate-based hairs, whitish-pithy, 3 mm. thick above; upper internodes 5–8 cm. long; upper leaves 10–14.5 cm. long, 2.5–4 cm. wide, broadest near or slightly above the middle, acuminate to an obtusish callous tip and somewhat falcate, cuneate at base (the cuneate base entire, 3–5 cm. long), crenate-serrate with about 9–24 pairs of depressed callous-tipped teeth (these 0.5–1 mm. high, 3–9 mm. apart), above brownish green, evenly but not densely tuberculate-strigillose with mostly deciduous hairs with small persistent lepidote bases, more densely antrorse-strigose along the chief nerves, essentially smooth to the touch, in age slightly shining and somewhat bullate with impressed veins and veinlets, beneath lighter brownish green, uniformly but not densely strigillose on surface and veins, triplinerved 3–4 cm. above the base, 4–5 mm. wide at base, the bases of each pair not connate; panicle small, much surpassed by the upper leaves, more or less ternately divided, the peduncle 2 cm. long, the panicle as long, the bracts small, linear, 7 mm. long or less, subscarious; phyllaries (in flower) brownish, 3.2–3.7 mm. long, 2–2.3 mm. wide; pistillate flowers all paleate, their pales similar to the phyllaries, their ovaries (immature) obovoid, obcompressed, perfectly glabrous, 1.2 mm. long, with a distinct inflexed beak, their corollas cylindric, 2-

toothed, white, glabrous, 1.6 mm. long; single pale of the disk oblong, obtuse, ciliate, 2.5 mm. long; ovaries of the hermaphrodite flowers villous at apex, their corollas (immature) white, 2.5 mm. long, hispidulous on the teeth.—CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., July 20–22, 1940, *Woodson & Schery 658* (U. S. Nat. Arb. No. 124226, TYPE).

The only close ally of this species is *C. subsessilifolium* Hieron., of Ecuador, fragments from the type of which are in the U. S. National Herbarium. In that species the branches are described as "setose-hirtous with erect hairs" [Hieronymus] or "villous with erect hairs" [O. E. Schulz], the leaves are very rough above, antrorse-hirsute beneath, the larger subcordate at base, and the phyllaries are narrowly ovate, acuminate, 5 mm. long, with recurved reddish apex.

RUMFORDIA POLYMNIOIDES Greenm.—CHIRIQUÍ: vicinity of "New Switzerland," central valley of Río Chiriquí Viejo, alt. 1800–2000 m., Jan. 6–14, 1939, *Allen 1413* (U. S. Nat. Herb.). Previously known only from Costa Rica.

LIABUM POLYANTHUM Klatt.—CHIRIQUÍ: Chiriquí Viejo Valley, April 26, 1938, *G. White 93* (U. S. Nat. Herb.); vine climbing to 8 m. on stumps, vicinity of "New Switzerland," central valley of Río Chiriquí Viejo, alt. 1800–2000 m., Jan. 6–14, 1939, *Allen 1415* (U. S. Nat. Herb.). Previously known only from Costa Rica.

LIABUM SAGITTATUM Sch. Bip.—CHIRIQUÍ: trail from Cerro Punta to head-waters of Río Caldera, alt. 2250–2500 m., Jan. 14, 1939, *Allen 1458* (U. S. Nat. Herb.). Not previously known north of Colombia.

JUNGIA FERRUGINEA L.f.—CHIRIQUÍ: vicinity of "New Switzerland," central valley of Río Chiriquí Viejo, alt. 1800–2000 m., Jan. 6–14, 1939, *Allen 1367* (U. S. Nat. Herb.); liana climbing 30 m. into tops of largest trees, vicinity of Cerro Punta, alt. 2000 m., Jan. 21–24, 1939, *Allen 1520* (U. S. Nat. Herb.). Previously known from Costa Rica and northern South America.

Explanation of Plate

PLATE 19

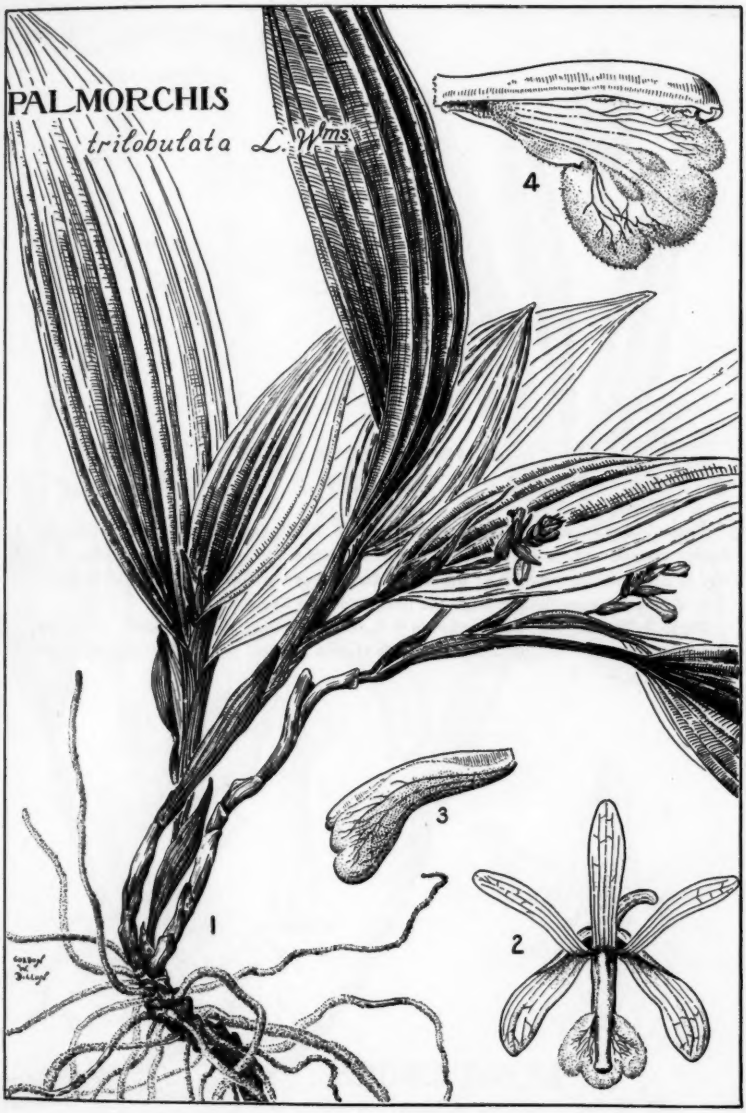
Aechmea Allenii L. B. Smith. From type specimen, *P. H. Allen 2378*, in the United States National Herbarium.

WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 20

Palmorchis trilobulata L. O. Williams: fig. 1, plant, × ½; fig. 2, flower opened out, × 2; fig. 3, lip and column from the side, natural position, × 3; fig. 4, column and lip with the lip expanded, × 4.



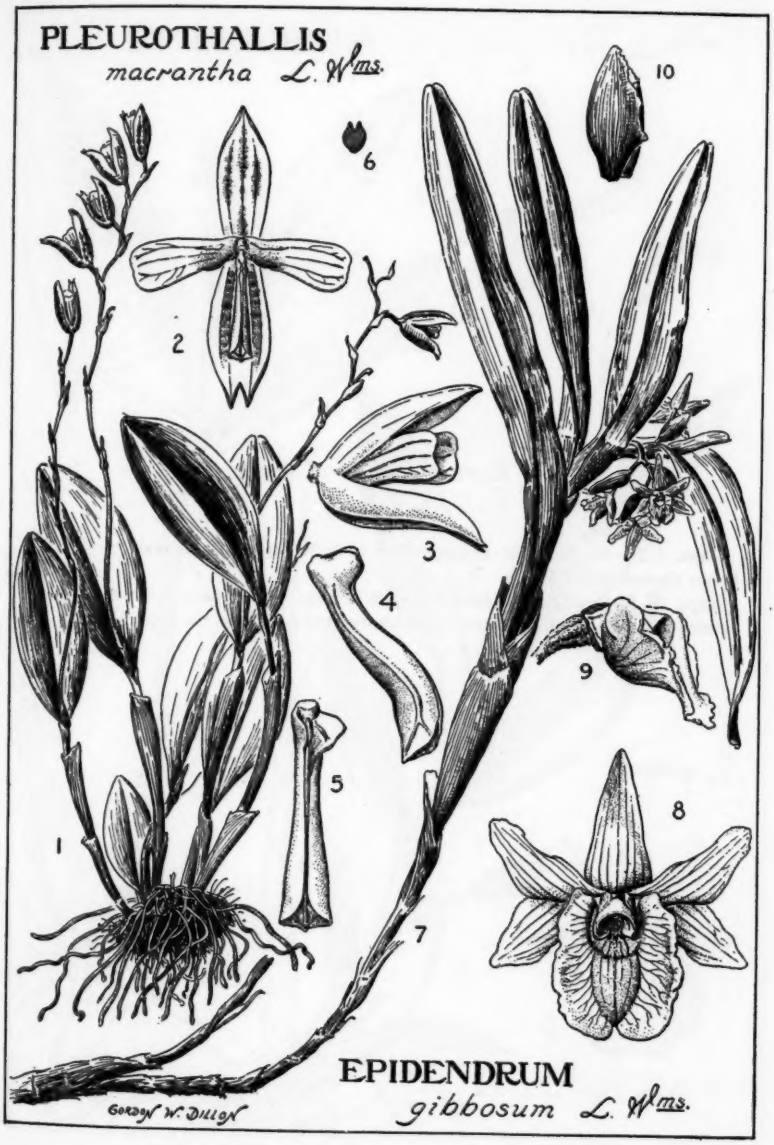
WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 21

Figs. 1–6. *Pleurothallis macrantha* L. O. Williams: fig. 1, plant, ×½; fig. 2, flower opened out, × 1½; fig. 3, flower from the side in natural position, × 1½; fig. 4, lip from the side, × 3; fig. 5, lip from above with one basal lobe spread out, × 3; fig. 6, cross-section through the middle of the lip, × 3.

Figs. 7–10. *Epidendrum gibbosum* L. O. Williams: fig. 7, plant, × ½; fig. 8, flower expanded, × 2; fig. 9, lip from the side in natural position, × 2; fig. 10, floral bract, × 1.



WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 22

Figs. 1–2. *Epidendrum ellipsophyllum* L. O. Williams: fig. 1, plant, × ½; fig. 2, flower opened out, × 1½.

Figs. 3–5. *Epidendrum Allenii* L. O. Williams: fig. 3, plant, × ½; fig. 4, flower opened out, × 1½; fig. 5, column (and base of the lip) from the side, × 2½.

WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 23

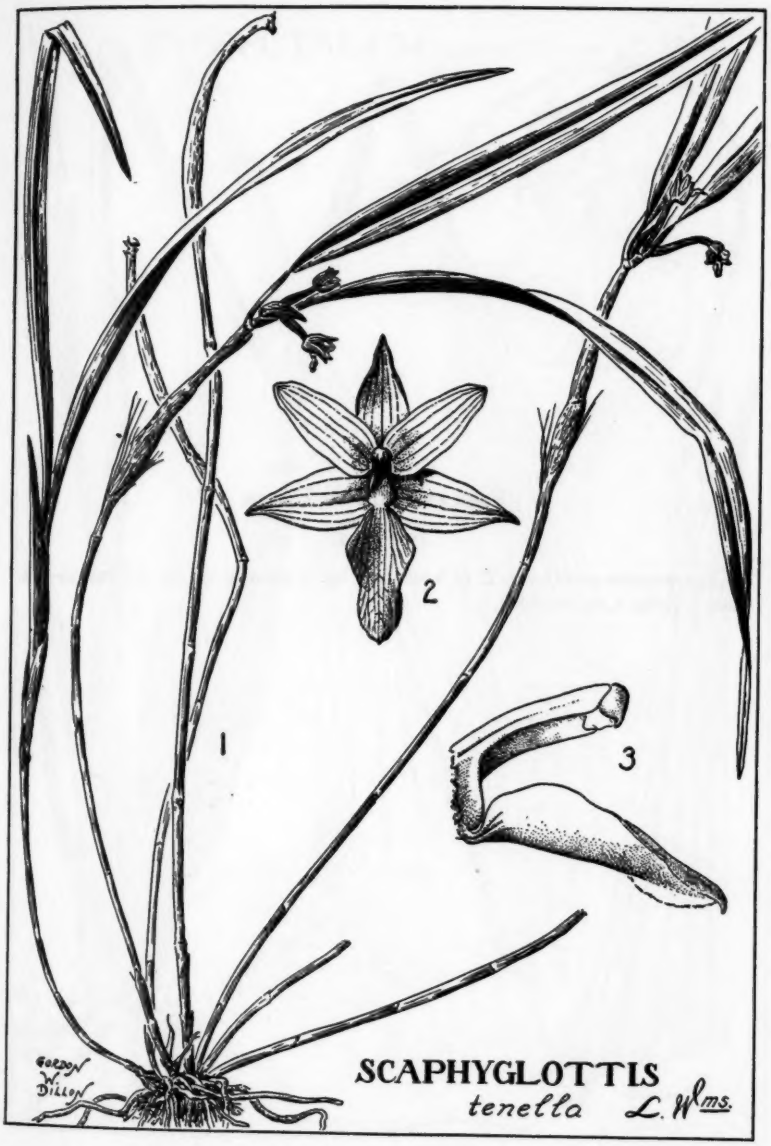
Epidendrum pendens L. O. Williams: fig. 1, plant × ½; fig. 2, flower opened out, × 1.

WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 24

Scaphyglottis tenella L. O. Williams: fig. 1, plant, × ½; fig. 2, flower opened out, × 2½; fig. 3, column and lip from the side, × 5.



WOODSON & SCHERY—FLORA OF PANAMA

Explanation of Plate

PLATE 25

Zygopetalum parviflorum L. O. Williams: fig. 1, plant, × ½; fig. 2, flower opened out, × 2; fig. 3, lip extended, × 4.

WOODSON & SCHERY—FLORA OF PANAMA

THE CYTOGENETICS OF POA PRATENSIS[1]

WILLIAM L. BROWN

Cytogeneticist, United States Golf Association, Green Section, Washington, D. C.
Formerly Research Fellow, Henry Shaw School of Botany
of Washington University

Introduction

Poa pratensis L., the common Kentucky Blue grass, is universally recognized by taxonomists as an extremely variable species. Many different strains are included within the species, and although American botanists do not generally recognise them as being sufficiently distinct to warrant their segregation from *pratensis* they are conspicuously present. Basic information on their variability, inheritance, and methods of reproduction would not only make it possible to classify the various strains more efficiently but it would allow us to use the species to best advantage for pasturage, turf, etc. It would also indicate what improvements might be expected by breeding for superior strains and the methods to be followed in making such improvements.

In this investigation an attempt has been made to correlate data from morphological, cytological, and genetical studies in an effort to arrive at a clearer understanding of the behavior of the species.

Materials and Methods

Materials for this study have, for the most part, come from the Missouri Botanical Garden Arboretum, Gray Summit, Missouri. In the spring and summer of 1941 additional data have been obtained from plants growing in the nurseries of the United States Golf Association, Green Section, at Arlington, Virginia. Most of these plants came originally from estab-

[1] An investigation carried out at the Missouri Botanical Garden in the graduate laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

lished turf selected at various places throughout the United States.

At the Missouri Botanical Garden Arboretum eleven lots of seed from well-established clones were harvested in 1939, all being taken from open-pollinated panicles. The parent clones varied in width from 1 to 3 feet and were growing in an area approximately 50 feet square. There was therefore considerable opportunity for cross-pollination between clones. Seed was sown in the greenhouse the first week in January 1940. In February individual plants were transferred to 2-inch pots and removed to a cool greenhouse. They remained here until April, at which time they were moved to the nursery.

Both permanent and smear methods have been employed in cytological studies. La Cour's 2 BD fixative was used in all cases where permanent preparations were desired. The Feulgen staining technic, supplemented by crystal violet and acetocarmine, was used to advantage.

PROGENY ANALYSES

G.S. Lot 1.—Seeds from open-flowering panicles were collected from a single clone in 1939. The resulting progeny was analyzed after two year's growth, i. e., after the plants had reached full maturity. Of 133 plants in the family, 131 were uniform and morphologically closely resembled the mother parent. These were of tall upright habit, possessing relatively narrow leaves and average-size panicles. The two aberrant plants were easily distinguished by their low habit of growth, darker green color, and wider leaves.

G.S. Lot 2.—In this lot 103 plants were grown to maturity, 102 of which were morphologically constant and indistinguishable from the female parent. They resembled those of Lot 1 very closely and were definitely of the "hay" type. They were tall, with narrow leaves and panicles of medium size. The one aberrant plant was a low, spreading type with wide leaves and a heavy inflorescence. It resembled somewhat the "off types" in Lot 1, but deviated from the maternal parent even more than the aberrants of the first lot.

G.S. Lot 3.—Of the 100 plants composing this progeny all were absolutely uniform, with growth habit and morphology resembling closely those of the first two lots.

G.S. Lot 4.—These plants represent a type very different from those of the previous lots. They are characterized by low growth, light green leaves, and small purple inflorescences. Fifty-five seedlings were raised to maturity, all of which were absolutely uniform and indistinguishable from the maternal parent.

G.S. Lot 5.—The parent of this lot of plants was of tall upright growth habit. The leaves were slightly more than medium width and dark green in color. Panicles were of average size. Progeny of this parent, consisting of 55 plants, may be segregated into two distinct classes: (1) those identical with the parent, to which class belong 45 of the plants; (2) 10 plants with lax, glossy, light green leaves almost twice as wide as those of the parent, and inflorescenses extremely long and heavy. By observation alone one could easily place each of the plants into one of these two classes. No intermediates occurred.

G.S. Lot 6.—Of the 60 plants comprising this selection, all were uniform with the exception of some slight differences in time of flowering. However, this variation can hardly be referred to as of a genetic nature since it might easily be the result of soil heterogeneity, differences in soil moisture or disturbances from cultivation.

G.S. Lot 7.—This progeny, consisting of 60 plants, was of a type almost identical with Lot 1. They were strikingly uniform throughout and showed no morphological deviation from the parents.

G.S. Lot 8.—As a whole, these plants resembled the aberrants of Lot 3. They are characterized by tall culms, wide, lax, light green leaves, and very long panicles. The progenies were surprisingly uniform and, with one exception, quite similar morphologically to the maternal parents. The one aberrant in a progeny of 60 plants possessed stiff, narrow, dark green leaves and a small, almost dwarfed inflorescence.

G.S. Lot 9.—The 60 plants grown to maturity were uniform throughout and indistinguishable from the maternal parent.

G.S. Lot 10.—The plants from which seed for this progeny was collected were characterized by low, spreading growth and very vigorous habit. The leaves were wide (5–6 mm.) and dark green in color. Panicles were large, heavy, and late-flowering. Fifty of the 60 seedlings closely resembled the female parents morphologically, while the other 10 were variants. However, as has been shown for Lot 5, the variants were quite uniform among themselves. All 10 plants fell into a class characterized by narrow leaves and small panicles.

G.S. Lot 11.—These plants were typical "hay" type with tall upright growth, moderately narrow leaves and average-size panicles. The parent clone was of this general type and 53 of the 55 plants grown from seed were almost identical with the parent. The two aberrants differed markedly from the typical plants. They were a low, spreading, wide-leaved type with very long heavy panicles.

TABLE I

SUMMARY OF MORPHOLOGICAL VARIATION IN GRAY SUMMIT PROGENIES

	Number of plants	Number of aberrants	Per cent aberrants
G.S.– 1	133	2	1.50
G.S.– 2	103	1	0.97
G.S.– 3	100	–	–
G.S.– 4	55	–	–
G.S.– 5	55	10	18.18
G.S.– 6	60	–	–
G.S.– 7	60	–	–
G.S.– 8	60	1	1.66
G.S.– 9	60	–	–
G.S.–10	60	10	16.66
G.S.–11	55	2	3.63

All the plants described in the foregoing paragraphs were obtained from seed collected from open-pollinated panicles. With the exception of Lots 5 and 10, these progenies have been quite uniform and very similar to the maternal parents.

The Arlington plants were subject to a somewhat different

method of study. The seed had been harvested from single isolated plants in nursery rows. Collection was made not only from open-pollinated panicles but from inflorescences that had been isolated from foreign pollen by bagging prior to anthesis. In some instances seed-setting in parchment isolation bags was very poor, but enough seed was always produced for progeny analyses. Seedlings were started in the greenhouse and then transferred to nursery rows. Those from free-flowering and isolated panicles of the same plant were placed in adjacent rows for comparison. At the height of their flowering season they were analyzed morphologically in the same manner as were the G.S. progenies.

The contrast between progenies from isolation and open-pollination was sometimes very marked (pls. 28–29). For example, B-2 after open-pollination produced a uniform and maternal-like progeny typical of apomictic strains. The selfed progeny of this line, however, showed a degree of variation that might be expected only from sexually reproducing plants. Even before flowering, distinct differences between plants could be easily ascertained from vegetative characters, the variability in leaf width being especially noticeable (figs. 1 and 2). At the time of flowering distinct differences in the inflorescences, including size of panicles, number of florets per spikelet, etc., were evident. There also occurred in the selfed line of this progeny a number of weak plants, many of which did not survive beyond the seedling stage. Other weak plants which were grown to maturity exhibited characters entirely foreign to *P. pratensis*.

Another example of very distinct differences in open and selfed lines of the same strain is provided by selection B-6. Here also the progenies grown from open-pollinated panicles were uniform and exhibited a tall upright habit of growth (pl. 28). The progeny produced after isolation, although not quite so variable as the selfs in B-2, was of an entirely different growth habit from that produced after open-pollination, almost without exception being low-growing, spreading, semi-decumbent types (pl. 29).

In contrast to the B-2 and B-6 seedlings, those of B-17 and B-1 showed absolutely no differences between open and selfed lines, and all were essentially maternal-like in appearance (pls. 26 and 27).

In addition to the three strains mentioned above, progenies of open and selfed lines of eleven other selections were grown

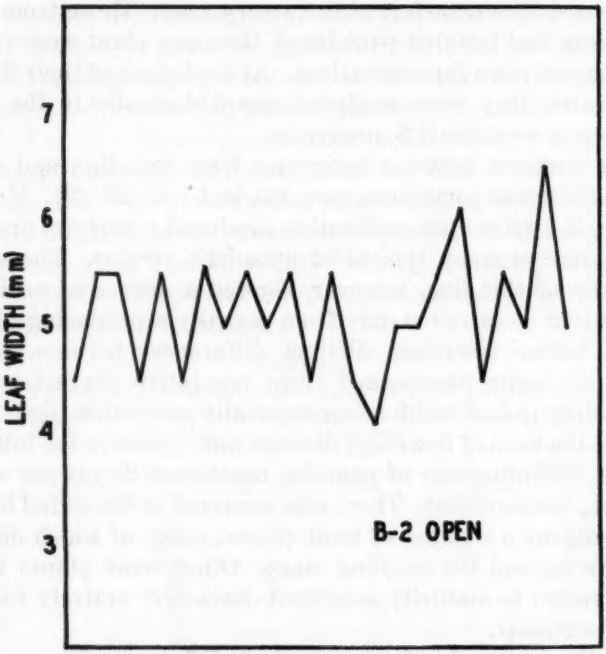


Fig. 1. Variation in leaf width in B-2 progeny after open-pollination.

to maturity and analyzed. Six of these progenies showed very marked differences in the number of aberrants occurring after selfing and after open-pollination, the selfed line always producing more variable types than the open-pollinated one. Strains which had previously been concluded to be apomictic behaved as sexually reproducing plants when they were isolated from foreign pollen. When segregation of a degree ex-

hibited by some of these selfed lines does occur it must be assumed that reproduction has taken place by gametic union. If this is true, what is there to prevent the open-pollinated lines of the same plant from functioning in a like manner? Assuming that the plant is potentially sexual, one might logically have expected the open-pollinated lines whose parents are sub-

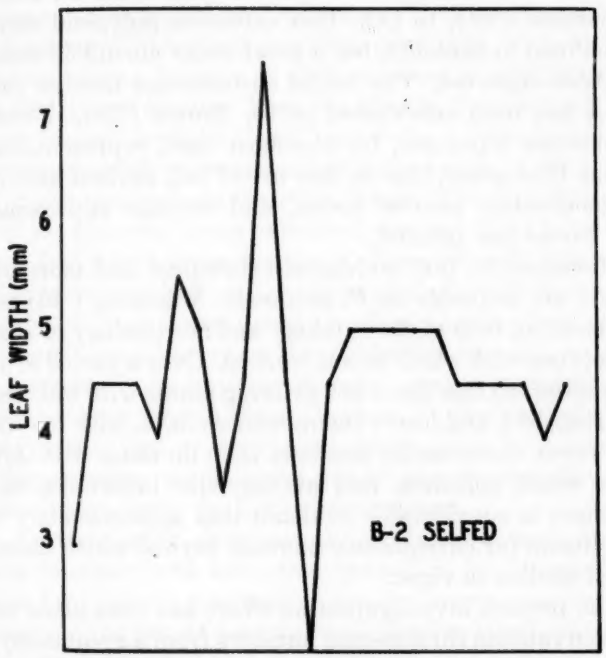


Fig. 2. Variation in leaf width in B-2 progeny after selfing.

ject to cross-pollination with other plants to exhibit more variation than the selfs. This, however, did not occur.

As a result of these analyses it is concluded that there are within *Poa pratensis* both sexual and asexual strains. Although the asexual strains are apparently predominant, the sexual ones occur frequently in most populations. Aside from purely sexual and purely asexual strains, there are those

plants which apparently reproduce asexually when open-pollinated but which reproduce sexually when selfed.

CHROMOSOME STUDIES

The polyploid nature of the genus *Poa* has long been established with 7 as the accepted base number. Within *Poa pratensis* somatic chromosome numbers range from 28, recorded by Avdulow ('31), to 110. This extensive polyploid series is not confined to euploidy, but a great many aneuploid numbers have been reported. The modal chromosome number for the species has been established as 56, Brown ('39). These 56-chromosome types are, for the most part, representative of average Blue grass, that is, they are of tall, upright habit, possess moderately narrow leaves, and average approximately three florets per spikelet.

Unfortunately, few correlated cytological and morphological data are available on *P. pratensis*. Müntzing ('40) makes some mention both of the cytology and morphology of some of the biotypes with which he has worked. Over a period of years I have observed that those low-growing plants with wide leaves, large spikelets, and heavy inflorescences have, with few exceptions, lower chromosome numbers than do those with narrow leaves, small spikelets, and average-size inflorescences. In fact, there is considerable evidence that approximately 6n is the optimum for chromosome increase beyond which there is a marked decline in vigor.

In the present investigation no effort has been made to obtain even random chromosome numbers from a great many lots of plants. Instead, one lot was selected from which it was felt that chromosome data would be of particular significance. The great majority of progenies, after open-pollination, exhibited little, if any, variation and were eliminated as possible material for chromosome studies. After studying the morphological variability in G.S. Lot 5 it was immediately apparent that chromosome data from this progeny would be of special interest.

It will be remembered that the progeny of Lot 5, after open-

pollination, segregated into two distinct classes. Forty-five of the 55 plants were typical of the maternal parent while the remaining 10 were of a very different morphological type. Cytological examination of 35 of these plants has yielded some very interesting facts on the morphological effects of chromosome elimination from the original complement. The typical plants of the progeny, for the most part, possessed 49 somatic chromosomes (table II). The "off types," or aberrants, all of which belonged to a single morphological type, were, with one exception, shown to have 42 chromosomes, or one less genom than the typical plants. Thus the change from a moderately narrow-leaved, upright "hay" plant to a wide-leaved, low-growing one with increased vigor is the result of the elimination of one genom from the germ-plasm. The fact that all but one of the aberrant types contained one less genom instead of from 1 to 7 fewer chromosomes is of considerable interest. A number of 2n plus 1-, 2-, or 3- or 2n minus 1-, 2-, or 3-chromosome types have been investigated in other plants *(Zea, Datura,* etc.), and in most such cases the elimination or addition of even one chromosome was usually morphologically apparent. This, however, is not true in those plants of *P. pratensis* that have been studied. One of the typical plants (G.S. 5–5) possessed 47 chromosomes, yet it could not be morphologically distinguished from those with 49 chromosomes.

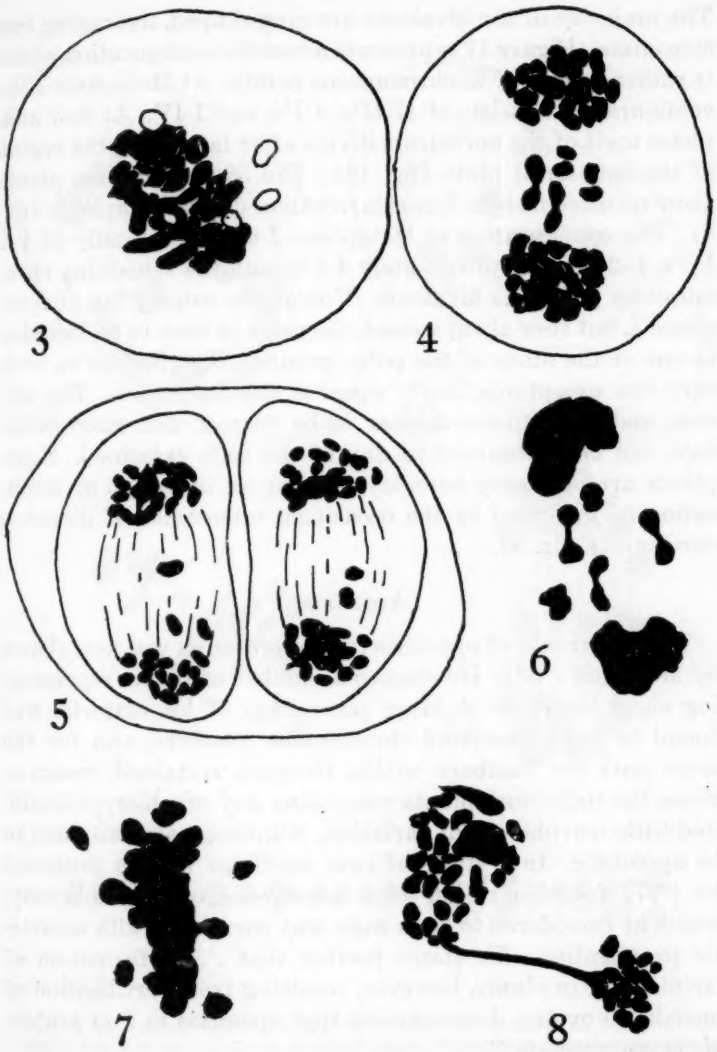
A few scattered chromesome counts have been made on plants selected from lots other than G.S. 5. Although these are so few that no conclusions can be drawn concerning the cytology of the lots as a whole, the following bit of information is of some interest. Lot 1, it will be recalled, produced a very low percentage of aberrants and is apparently an apomictic strain. Chromosome counts were made from six plants of this lot, and in all the 2n number was found to be 56. Four out of five plants from Lot 2, another apomictic strain, were found also to possess 56 chromosomes. The number for the fifth plant could not be exactly determined but it was between 55 and 58. Lot 10, which reproduces at least partially by gametic union, yielded plants with 42, 41, and 42 ± 1 chromosomes.

These data suggest that apomixis may be more prevalent in the higher chromosome types and that polyploids of approximately 6n reproduce sexually.

TABLE II
SUMMARY OF CHROMOSOME NUMBERS IN G.S. LOT 5

Plant	2n	Type of plant
5– 1	49	Typical
5– 2	42	Aberrant
5– 3	49	Typical
5– 4	49	Typical
5– 5	47	Typical
5– 6	49	Typical
5– 7	48–49	Typical
5– 8	48±1	Typical
5– 9	42	Aberrant
5–10	49–50	Typical
5–11	49	Typical
5–12	49	Typical
5–13	49	Typical
5–14	49	Typical
5–15	49	Typical
5–16	42	Aberrant
5–17	49	Typical
5–18	49	Typical
5–19	49	Typical
5–20	48–49	Typical
5–21	43±1	Aberrant
5–22	42	Aberrant
5–23	49±1	Typical
5–24	49	Typical
5–25	49–50	Typical
5–26	49±1	Typical
5–27	49	Typical
5–28	41–42	Aberrant
5–29	49	Typical
5–30	49	Typical
5–31	49	Typical
5–32	50	Typical
5–33	42	Aberrant
5–34	49–50	Typical
5–35	49	Typical

Meiosis: Osbervations on meiosis were made on a number of plants wnose chromosome numbers had been previously determined somatically. Although meiosis in *P. pratensis* is not regular, the irregularity is not of a degree that might be expected in a highly polyploid species (figs. 3–13). Pairing is, for the most part, by bivalents, although univalents, trivalents, and quadrivalents have been observed in all cells examined.



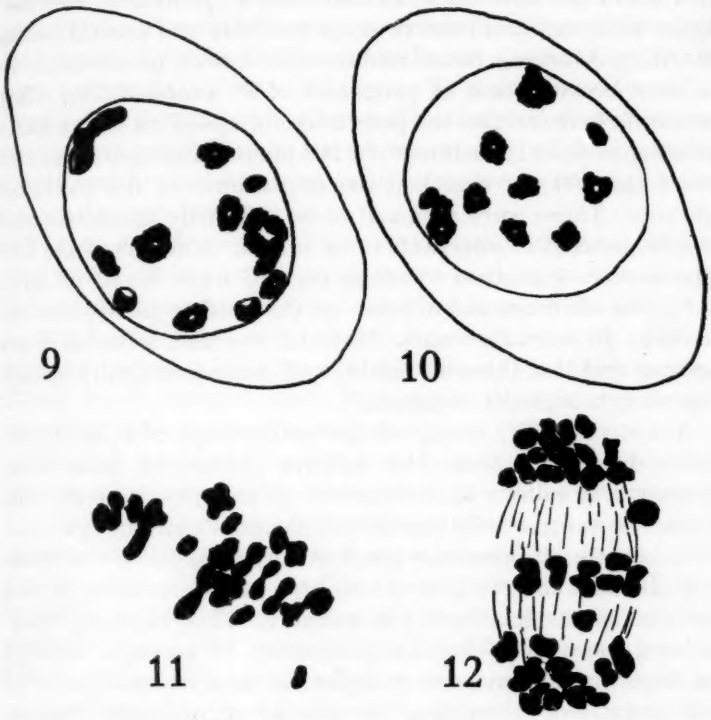
Figs. 3–8. Camera-lucida drawings of meiotic chromosomes in *Poa pratensis*, × 2000: fig. 3. Metaphase I from an apomictic plant showing 4 univalents, 3 trivalents, and approx. 23 bivalents, univalents in outline; fig. 4. Anaphase I from apomictic plant showing univalents dividing—not all polar chromosomes shown; fig. 5. Anaphase II showing lagging; fig. 6. Univalents dividing at Anaphase I, sexual plant; fig. 7. Metaphase I showing non-conjugation in apomictic plant; fig. 8. Anaphase I depicting unequal distribution with a dicentric chromosome.

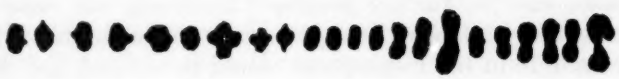
The majority of the bivalents are ring-shaped, averaging two chiasmata. Figure 11 represents a meiotic configuration which is rather typical of 42-chromosome plants. At Metaphase I the configuration consists of 17 II's, 4 I's, and 1 IV. At first anaphase most of the univalents divide after lagging in the region of the equatorial plate (fig. 12). The 56-chromosome plants show no more meiotic irregularity than do the hexaploids (fig. 3). The configuration at Metaphase I consists usually of 1–2 IV's, 1–2 III's, approximately 4 I's, with the remaining chromosomes paired as bivalents. Univalents usually lag at Anaphase I, but they always reach the poles in time to be included in one or the other of the polar groups. Distribution is, with very few exceptions, fairly equal at the anaphases. The tetrads and microspores appear to be normal, and micronuclei have not been observed in any of the cells examined. Some plants are obviously heterozygous for an inversion or duplication as indicated by the occasional occurrence of dicentric chromatids (fig. 8).

APOMIXIS

The occurrence of apomixis in *Poa pratensis* was first shown by Müntzing ('33). He studied a number of plants representing eight biotypes. A large percentage of his material was found to have aneuploid chromosome numbers, and for the most part the numbers within biotypes remained constant. Since the individual plants composing any one biotype exhibited little morphological variation, Müntzing assumed them to be apomictic. In a study of twin seedlings in *Poa pratensis* he ('37) found a rather high occurrence of polyembryony, which he considered to be in some way correlated with apomictic propagation. He states further that . . . "formation of 'triploid' twin plants, however, resulting from fertilization of unreduced ovules, demonstrates that apomixis in *Poa pratensis* is not absolute."

Akerberg ('36) investigated seed production in eighty biotypes of *P. pratensis*. After employing both emasculation and free-flowering methods he concluded that pollination was nec-





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Figs. 9–13. Camera-lucida drawings of meiotic chromosomes in *Poa pratensis*, × 2000: figs. 9 & 10. Diakinesis in sexual plant, drawn in 2 planes—3 univalents, 16 bivalents, and 1 quadrivalent; fig. 11. Metaphase I from sexual plant showing 4 univalents, 17 bivalents, and 1 quadrivalent; fig. 12. Anaphase I from sexual plant showing lagging chromosomes—not all polar chromosomes shown; fig. 13. Metaphase chromosomes of fig. 11 drawn separately.

essary for seed production, but that pollen from *Poa alpina* had about the same effect as that from *P. pratensis*. For biotypes with aneuploid chromosome numbers and partial pollen sterility, Åkerberg postulated apomictic seed production. In a later investigation of progenies of *P. pratensis*, he ('39) attempts to determine the percentage of apomixis on the basis of morphological constancy. Of 703 plants investigated a little more than 90 per cent had the appearance of the maternal parents. These were assumed to be primarily apomictic and the 10 per cent of aberrants to be sexual. When 58 of the 703 plants were examined cytologically, 43 were found to have the same chromosome number as the mother plant; the remaining 15 were aberrants. Material was also collected from nature, and "of these 44 families, 37 were practically speaking morphologically constant."

Armstrong ('37) interprets the embryology of *P. pratensis* quite differently from the authors previously mentioned. Although he admits the occurrence of aneuploidy he still believes the species to be sexual and assumes that only gametes with certain chromosome numbers are capable of functioning. He has observed, in the embryo sac, a variation in the position of the functioning megaspore. This, he says, "provides a mechanism for the elimination of megaspores with an abnormal chromosome complement and for the choice of the megaspore containing the normal chromosome complement." On the basis of meiotic pairing he has assumed that 6/16 of the pollen would contain the normal chromosome complement, and he further states, "Assuming the same frequency of irregularity in megasporogenesis as in microsporogenesis, 6/16 of the megaspores would be normal, and with a choice of four megaspores the chance of obtaining one with the normal number is quite good."

Tinney ('40) found that the young ovules of *P. pratensis* always show a single, elongated, very conspicuous macrospore mother cell. The nucleus of this cell undergoes meiosis, and usually three haploid macrospores are formed, all of which subsequently disintegrate. The embryo sac arises from a cell

of the nucellus and when mature consists of three antipodals, a primary endosperm cell containing two nuclei and the egg apparatus. The diploid egg, according to Tinney, develops into a proembryo by parthenogenesis, the development beginning frequently before pollination. He did not observe endosperm development until after pollination and therefore concluded that pollination or the growth of pollen tubes in stylar tissue may be necessary for endosperm development and consequently seed development.

Tinney and Aamodt ('40) have analyzed 102 progenies of *Poa pratensis* in an attempt to arrive at the type of seed development in various biotypes. In 48 of them no variant types occurred, and these were thought to be apomictic. In one progeny, however, 21.9 per cent of the types were variant. These, it was thought, might have arisen through mutation or as a result of sexual reproduction.

Since all investigators of the mode of reproduction in *Poa pratensis* have shown that apomixis is one of the predominant factors involved, many have assumed that this phenomenon is of general occurrence within the species and can be taken advantage of in selection, etc. This assumption is to some extent undoubtedly true, but in view of the results obtained from this study it seems that we must distinguish between apomixis after selfing and apomixis after crossing or open-pollination.

Apomixis after Open-Pollination: It has been shown earlier that in lots B-2 and B-6 two very different types of progeny result when the same plants are selfed and allowed to produce seed without isolation. In plants reproducing by open-pollination the resulting progeny is essentially maternal-like morphologically and exhibit little, if any, variation within lines. Since *Poa pratensis* is an extremely diverse species it must, it seems, be assumed that constant morphological types of the nature just mentioned are being produced apomictically. The fact that foreign pollen must be present for the production of uniform progenies, however, is somewhat unusual and especially significant in the behavior of the species.

Apomixis after Selfing: If plants of strains B-2 and B-6 and

some other strains are isolated by bagging, progenies in direct morphological contrast to those obtained after open-pollination result. A wide range of variation both in vegetative and inflorescence characters usually results in these lines. Most of these strains segregate in a manner that would be expected only if the plant were reproducing sexually. These preliminary results indicate that in some strains of Kentucky Blue grass apomixis is dependent upon the presence of foreign pollen (pollen from another strain). The most logical hypothesis explaining the phenomenon is that the presence of foreign pollen on a stigma stimulates the development of some somatic cell of the embryo sac which, after the initial stimulation, goes ahead and functions as an embryo. Should the inflorescence of the same plant be bagged, thereby eliminating all foreign pollen, reproduction then takes place by gametic union (with the egg cell perhaps functioning normally). Besides explaining the differences in progeny obtained from the same plant after isolation and free-flowering, this hypothesis explains the varying but usually small percentage of aberrant forms present in most progenies of open-pollinated plants; i. e., they are the result of selfing, whereas the majority of the florets have received a stimulation from foreign pollen (as might be expected to occur in natural populations or in nursery rows).

The recent work of Englebert ('41) is very interesting in light of the results reported in this paper. Miss Englebert reports that in several species of *Poa*, including *Poa pratensis*, no endosperm was developed in emasculated, non-pollinated florets although embryos were found. She concluded, therefore, that the "germination of pollen on the stigmas stimulated the development of the aposporous polar cell to an endosperm (pseudogamy)." Although no embryological investigations have been attempted in the present study, the evidence from progeny analyses strongly indicates that in some strains of *P. pratensis* pollen plays a much more important role than the mere stimulation of endosperm development.

Several objections may be raised to the hypothesis just pre-

sented. For example, the increased temperature within a parchment bag might result in mutation and therefore in aberrant types. If this were true, however, one would expect comparable results in all selfed lines since the same methods of isolation were used in all plants investigated. As was noted earlier, this is not the case. Some strains, for example, B-6, produce nothing but uniform progenies regardless of whether or not the progenies are the product of isolation or open-pollination. As a further check on this point, three strains of *P. pratensis* which were thought to be apomictic were selected in 1940. Progenies of these were grown after (1) isolation by bagging, (2) isolation by caging, and (3) open-pollination. At maturity all three showed some slight random variation, but within any one strain there were no significant differences between plants produced under the different conditions. Yet in other selections which morphologically were almost identical with some of these lots, marked differences occurred in the number of variants produced after isolation and after open-pollination.

Behavior of Apomicts in Generations beyond the F_1: In most instances the demonstration of apomixis in Blue grass has been the result of progeny analyses based on one generation of plants. As a result, few data are available on the behavior of the supposed apomicts beyond the first generation. For example, it is not definitely known whether or not a selection of *Poa pratensis* which produces a uniform progeny in one generation will continue to do so in following generations, yet, for practical purposes in seed production and strain improvement, this information is necessary. Records obtained from three selections of *Poa pratensis,* each of which has been maintained for three plant generations, shed some light on this problem. In each of these selections progenies have been studied from both selfed and open-pollinated lines.

B-37.—The plant from which this line was started is typical of "average" Blue grass, i. e., it is upright in habit, has narrow dark green leaves, average-size panicles, and produces an abundance of seed. The first-generation seedlings obtained after free-flowering were uniform and very similar to the ma-

ternal parent. However, approximately 15 per cent aberrant types occurred in the selfed lines, and these exhibited a rather wide range of variability. The second and third generations behaved essentially in the same manner. The open-pollinated lines were again constant morphologically while the selfs showed considerable variation.

B-2.—Although a different type of plant morphologically, the B-2 progeny for three generations behaved very like that of B-37. The plants resulting from open-pollination showed no significant variation, although a number of "off types" occurred after selfing. These were, as a group, less vigorous and of a less desirable type than their parent. There were, nevertheless, a few exceptional cases in which promising segregates were obtained from selfed lines.

B-30-19.—In this strain, as in the two previous ones, asexual reproduction, resulting in uniform progenies, seems to function without change for at least three generations. In each generation, however, aberrant forms resulted from selfing.

TABLE III

VARIATION IN PROGENY OF OPEN-POLLINATED LINES

Selection number	Per cent aberrants		
	1939	1940	1941
B–37	4.32	3.81	4.00
B– 2	1.63	3.21	1.71
B–30–19	0.09	0.09	1.04

These results indicate that in apomictic or otherwise asexually reproducing strains of *Poa pratensis* progenies may be grown or strains may be reproduced by seed without the interference of segregation in later generations. Deviation from type amounting to from 1 to 5 per cent of the total population would not likely have an undesirable effect on these selections when used in pasturage or turf. However, it cannot be assumed that all *Poa pratensis* will behave in a manner exhibited by selections B-2, B-37, and B-30-19. As was shown earlier, G. S. Lot 5 and G. S. Lot 10 produce approximately 20 per cent

aberrants in progenies resulting from open-pollination. Deviations of this magnitude would soon result in a heterogeneous mixture if attempts were made to reproduce the types from seed.

Discussion

Amphimixis results in many and varied gene combinations and hence in an increased genetic morphological variability, but, due to a variety of both internal and external causes, only a small per cent of the gene combinations produced in any sexually reproducing species survives. As a result the majority of plant species remain more or less constant from generation to generation. There are, however, in the plant world a great many groups whose variability makes the delimiting of species exceedingly "difficult." It is interesting to note that the majority of these groups are those in which asexual reproduction is the predominant mode of propagation (Dobzhansky, '37). Under such a system any genetic change occurring within a species is not usually eliminated as it might well be if the species were sexual, but instead it is maintained and propagated vegetatively as a new clone. This soon develops into a variety of forms, a so-called "species complex." In *Poa pratensis* this condition is further accentuated by the operation of both amphimixis and apomixis within a single strain. Although evidence from progeny analyses indicates that the great majority of *Poa pratensis* strains reproduce normally by apomixis, in each of the progenies studied from 0.9 to 18 per cent of the offspring were found to be the product of sexual reproduction. In nature a great many of these "new" strains would be eliminated due to their inability to compete successfully with other strains, but a number of them might be expected to survive and these will, in many instances, further propagate their kind through apomixis. Thus it is evident that *Poa pratensis* is equipped not only for producing new or aberrant types but is especially well equipped for propagating these types vegetatively through seeds once they do occur.

Since both sexual and asexual reproduction have been demonstrated in *Poa pratensis,* information on the factors affect-

ing apomixis is a prime prerequisite to any strain-improvement program. However, little information is available on the causes of a breakdown in the sexual reproducing system in plants. Darlington ('37) has shown that when such a breakdown does occur it is usually replaced by some form of asexual reproduction. It has been further suggested that asexual reproduction may be the result of hybridization since many apomicts are known to be of hybrid origin. This is a possibility in *P. pratensis* which might well have originated as an alloploid hybrid.

Brown ('40) has shown that, despite the extreme variation exhibited by *P. pratensis,* there is a more or less constant grouping of all variables into two main complexes. One includes plants with wide leaves, many florets per spikelet, long and wide panicles, and many panicle branches. Into the other complex fall those plants with narrow leaves, few florets, short and narrow panicles, and few panicle branches. Regardless of what characters are considered or to what degree the variability may occur, the varying units always tend to group themselves into one of these two complexes. This suggests strongly that in the germ plasm of *P. pratensis* there are at least two entirely different elements. While it might be suggested that the differences between strains are a result of changes within the germ plasm, crossing-over, translocations, inversions, interchanges, etc., such differences would tend to occur at random and not in the distinct groups which have been demonstrated. It is impossible to prove conclusively the alloploid nature of *P. pratensis* without reproducing it artificially. Nevertheless, all its peculiarities point to a probable hybrid origin. Whether or not hybridization can be shown to be a basis for apomixis remains to be seen, but at least *P. pratensis* is another example of an apomictic species whose behavior is essentially that of a hybrid.

Chromosome Numbers and Apomixis: The correlation between per cent apomicts and chromosome number as exhibited in the G.S. plants is very interesting and perhaps significant. It will be recalled that in G.S. Lot 5 the chromosome numbers

were found to be either approximately 42 or approximately 49. This progeny contained 18.18 per cent aberrants. Likewise, G.S. Lot 10, containing 16.66 per cent aberrants, exhibited chromosome numbers of 42 and approximately 42. In contrast, six typical plants from Lot 1 and five from Lot 2 were found to have 2n numbers of 56. These lots yielded 1.50 and 0.97 per cent aberrants respectively. Although this evidence is not conclusive it does indicate that apomixis tends to increase as chromosome number increases. The evidence for a hybrid origin in the 42- and 49-chromosome plants is just as pronounced as it is in the octoploids. Therefore, according to these data, it must be assumed that chromosome duplication (perhaps following hybridization) is at least one of the factors affecting apomixis. On the other hand, it is not likely that any one or any few factors govern the operation of apomixis in *Poa*. Indeed, the isolation experiments suggest that the presence or absence of foreign pollen has a very marked effect on the functioning of asexual reproduction.

Genetics of the Various Genoms: Perhaps the most important contribution contained in this paper concerns the morphological effect of a duplication or elimination of chromosomes within a single strain. It is only logical to expect differences in morphological characters to be correlated with differences in chromosome numbers. Since, however, *Poa pratensis* is exceedingly variable both morphologically and cytologically and since it is not a plant which lends itself well to cytological study, in the past it has been difficult to arrive at any conclusion regarding the morphological effects of the addition or elimination of one or more genoms of the germ plasm. Two lots of G.S. plants, G.S. 5 and G.S. 10, have afforded an excellent opportunity for a study of this sort. These progenies, it will be recalled, segregated into two quite clear-cut types. The tall, upright one possessed narrow leaves and closely resembled the parent, while the second type was in direct contrast to the parent morphologically. The 2n number of the first type was 49, that of the second 42.

From these data two facts are evident. First, at least two

types of *P. pratensis* can be transformed into entirely different types morphologically by the addition or elimination of one set of chromosomes. From the practical standpoint this knowledge should be of considerable importance to those interested in producing Blue grass for specific purposes. If one could predict with reasonable accuracy the types of Blue grass expected to segregate from certain selected strains, a great many of the initial difficulties encountered in strain improvement would be eliminated. Second, at least some unstable chromosomal types may revert to more stable and potentially sexual forms. Thus, the odd-numbered 49-chromosome plants which would be quite unstable upon cross-fertilization have produced 42-chromosome plants whose chromosomal stability could be maintained regardless of whether reproduction takes place by sexual or asexual methods.

On the basis of these observations the extreme diversity of *Poa pratensis* can be fairly well explained, and our knowledge of the factors affecting the behavior of the species, although still not complete, suggests a number of new approaches to the problem. The presence of a long euploid series within *P. pratensis* results in considerable variation. The various odd-chromosome forms, most of which are being maintained asexually, more than double this original variation. The complexity is further accentuated by the simultaneous operation of apomixis and sexual reproduction within single strains and the ability of unstable chromosomal types to revert to potentially sexual forms.

SUMMARY

In eleven lots of plants of *Poa pratensis* grown from seed produced by open-pollination, aberrant types amounting to from 0.09 to 18.18 per cent of the populations have been observed within strains. Although the majority of progenies contained from 1 to 5 per cent aberrants, two partially sexual strains produced 16.66 and 18.18 per cent off types. In one lot which was investigated in detail the chromosome number of the maternal-type seedlings was 49, that of the aberrants 42.

In some strains of *P. pratensis* the behavior of progenies after bagging and open-pollination is very different. Certain strains which after open-pollination produce uniform, maternal-like progenies may after bagging produce highly variable progenies which are apparently the products of gametic union. To explain this phenomenon, an hypothesis is offered based on an apomictic stimulating effect of foreign pollen.

In certain of these cultures the transition from a typical "hay" type *Poa pratensis* to a low-growing, wide-leaved spreading type of plant was brought about by the loss of one genom from the germ plasm. It is further shown that chromosome complements composed of odd-numbered chromosome sets may segregate into stable even-numbered chromosomal types.

Apomixis and the factors affecting this type of reproduction are discussed in the light of the results of this investigation. Evidence is presented which shows that apomixis is more prevalent in high polyploids than in those strains characterized by lower chromosome numbers. It is suggested that *Poa pratensis* may have originated as an alloploid, partially apomictic hybrid.

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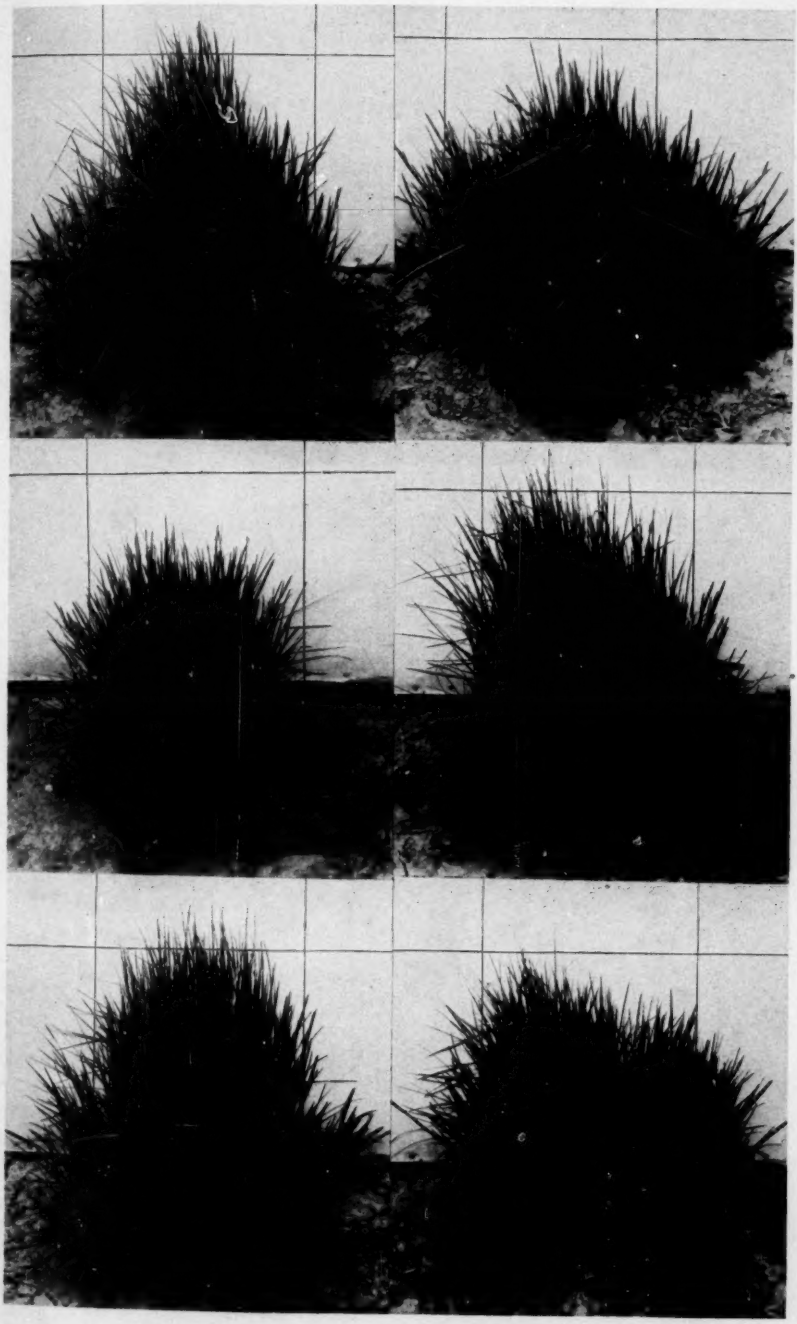
EXPLANATION OF PLATE

PLATE 26

Selection B-1. Typical representatives of progeny resulting from open-pollination. Compare with plate 27.

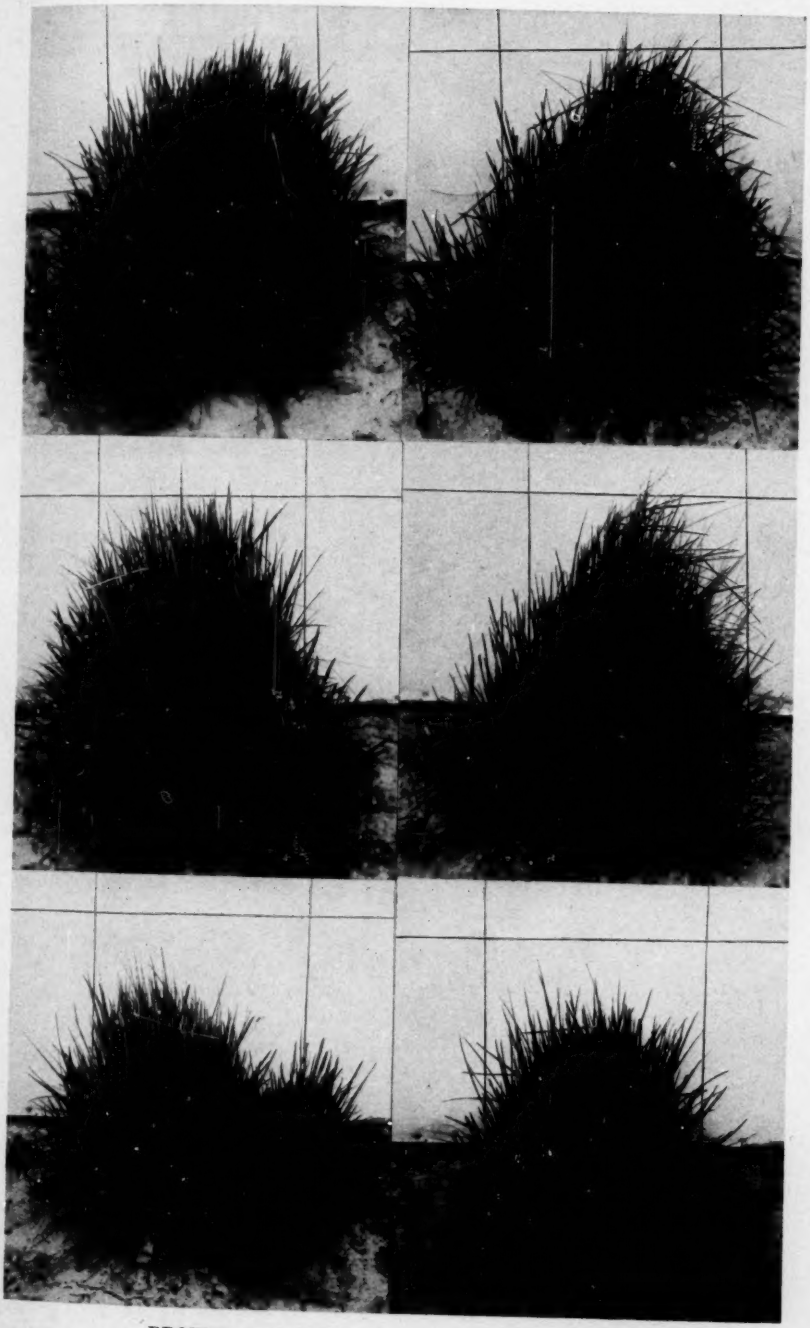


BROWN—CYTOGENETICS OF POA PRATENSIS

Explanation of Plate

PLATE 27

Selection B-1. Typical representatives of progeny resulting from selfing. Compare with plate 26. All plants shown in plates 26 and 27 are progeny of the same maternal parent.

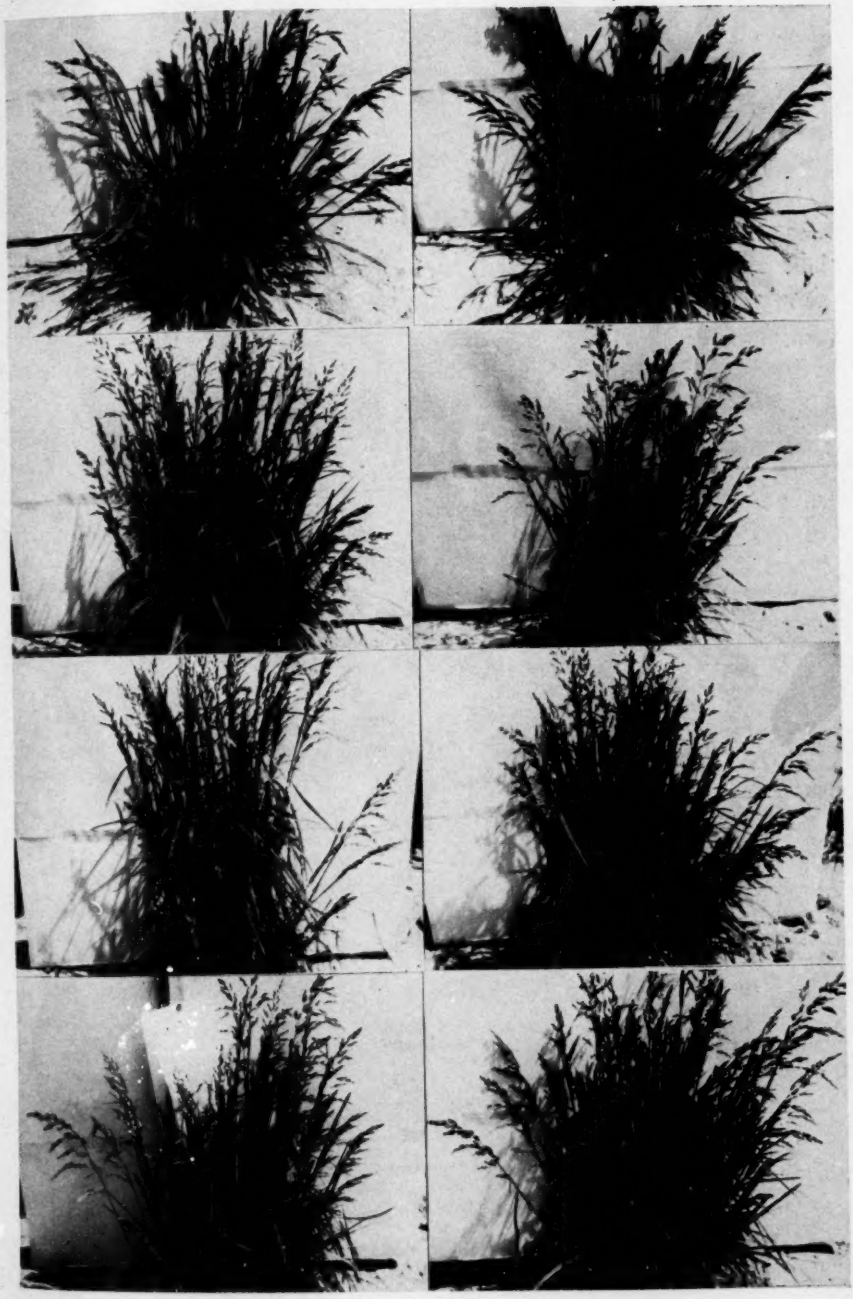


BROWN—CYTOGENETICS OF POA PRATENSIS

Explanation of Plate

PLATE 28

Selection B-6. Typical representatives of progeny resulting from open-pollination. Compare with plate 29.

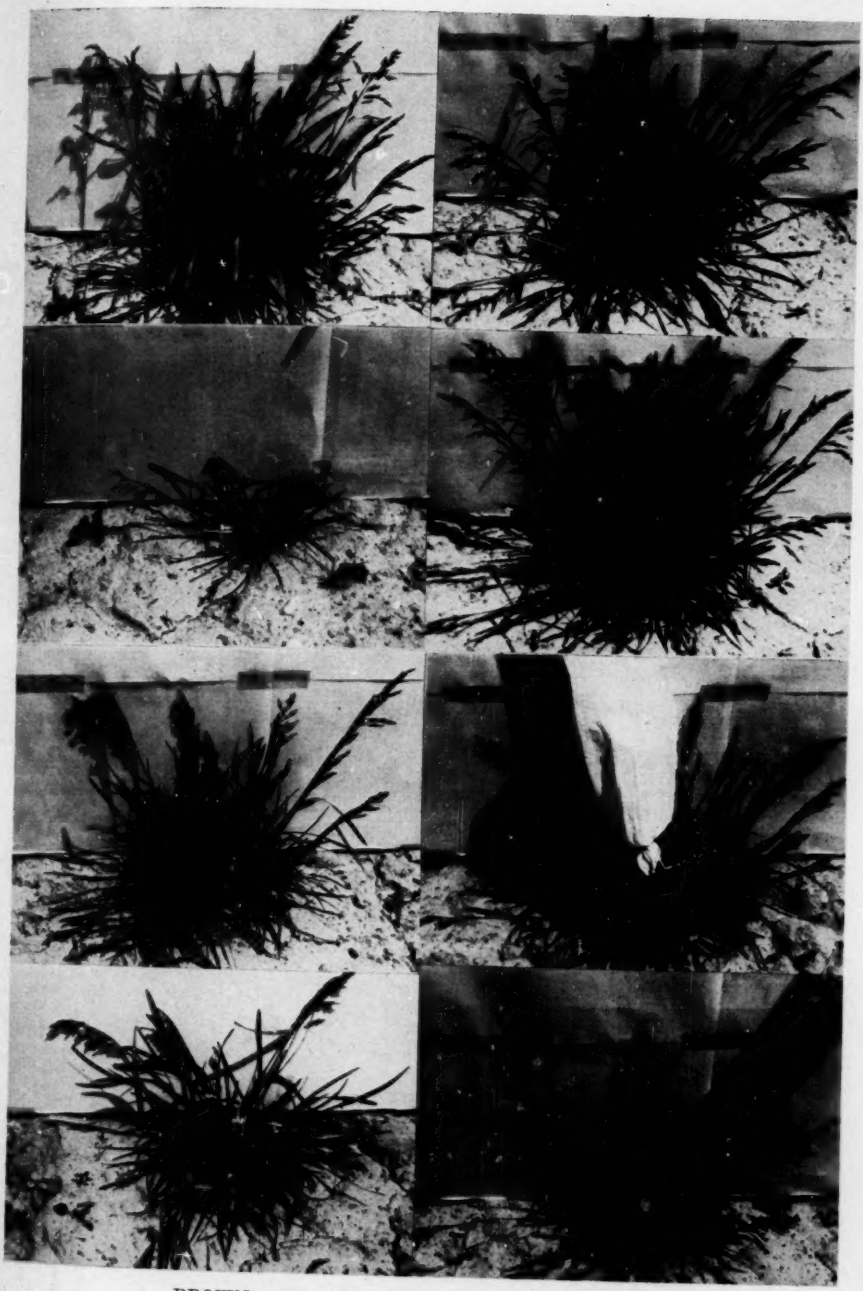


BROWN—CYTOGENETICS OF POA PRATENSIS

Explanation of Plate

PLATE 29

Typical representatives of progeny resulting from selfing. Note the variability and low, spreading habit of these plants as compared with those shown in plate 28. All plants shown in plates 28 and 29 are progeny of the same maternal parent.



BROWN—CYTOGENETICS OF POA PRATENSIS

GENERAL INDEX TO VOLUME XXVIII

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